THE GLASS INDUSTRY

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THE NATURE OF THE VITREOUS STATE

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TRANSLATED FROM SILICATE INDUSTRIELS, 1950

By F. W. PRESTON

PART I

Translator's note: In undertaking this translation, I have naturally been influenced by my own belief that it is a superior paper and worth translating. None the less, it should be understood that in translating it, I present M. Peyches' views, whether they agree with my own or not. I have not found it too easy to render M. Peyches' French into my own ideas of English, but believe I have succeeded fairly well in giving M. Peyches' views. In this I have had the valuable assistance of M. Gerard de Piolenc, of Owens-Corning Fiberglas Corporation, which I wish here to acknowledge.

Summary

In the first section the author briefly surveys the development of our thinking on the structure of glass over the last twenty years.

All these theories postulate the existence of a structural state characteristic of each temperature, a state which is attained, for example, in the course of a cooling period which is longer in proportion as the temperature is lower. This slowing-down, or time-lag, begins to be obvious below the softening point and becomes infinite below the lower limit of the annealing temperature.

The author suggests that some aspects of this time-lag are already perceptible even in the molten state and that some changes can be observed even at room temperature. In the light of these hypotheses, he tries to account for a number of facts which have been observed in industrial practice. Description of these facts is the subject matter of Section II.

In the third section, we seek experimental proof of structural hysteresis above the softening point. For this purpose, we use the expansion properties of glass in the form of filaments, since these are capable of extremely rapid cooling. There is evidence on the one hand of structural rearrangements at temperatures far below the lower limit of annealing, and on the other hand traces of structural states appropriate to high temperatures. Although in a qualitative sense the hypotheses we have made are confirmed, the rate of change, particularly at high temperatures, is out of proportion with what it seems necessary to demand in order to explain the scientific facts. The author suggests a dual process of structural compaction, the one tending to freeze the fluctuations in arrangement of the cations, the other to construct a wide mesh structure around the Si-O skeleton elements.

Our understanding of the structure of glass has made, in the course of the last twenty years, a considerable progress both at the theoretical and at the experimental level. Whereas during the preceding decades glass was described "from the outside" in the form of an over-all phenomenon in which we sought more particularly to determine the limits of solution of oxides one in the other, we have now commenced to think in molecular terms. Even though the older method of working permitted the development of numerous new glasses with properties more and more specialized, it remained sterile so far as an intimate knowledge of the glassy state is concerned. After there was available a rough concept of what the ultimate structure must be, it was possible not only to explain the old facts but to *predict* new properties, which is the fundamental course of science. This marked the turning point between the art of the glass maker and the science of glass.

At this point we may note the curious fact that the bulk of these investigations has not been made in laboratories of glass technology proper, but in laboratories of pure science or in industrial laboratories where glass is merely a side issue.

Glass workers themselves have entered the race tardily. Possibly this is the reason why technical observations and daily industrial facts continue to ignore both theory and the experimental observations of the laboratory, and may be in their turn ignored by the latter.

A paper presented at the meeting of the Belgian Association to encourage the study of glasses and silicate compounds, at Brussels, January 14, 1950.

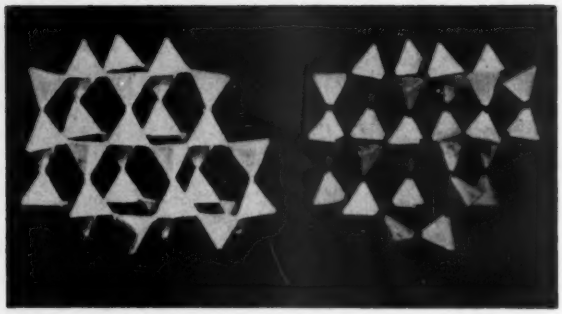


Fig. 1

The recent development of our industry, concerned primarily with the increase of output, has brought to the surface a number of new facts which it appears interesting to us to compare with the new theories of the structural constitution.

These *new facts* have but rarely the nature of a scientific observation. They may have appeared in the factory; they may have been noted as vaguely statistical matter by men who, though undoubtedly endowed with a keen ability to observe things, have not been in a position in the midst of the cares of manufacturing to do any experimental work, that is to say, to check and double check, to determine what is necessary and what is sufficient. On the other hand, if these facts constitute an advance, the frame of reference is a recollection that has been kept of a certain behavior of glass in previous years, in an era when one would never have dreamed of measuring carefully the physical properties that were supposed to have been developed.

For instance, if at this moment we had some reason to suspect that a glass specimen, whose thermal history was known and which had been submitted for a very long time even in the cold state to the action of an intense alternating electric field capable of disturbing the network, ought to approach a definite equilibrium at the temperature in question — in this case, so to speak, to settle down — it would be of the greatest interest to measure the density of a glass plate from a high frequency condenser which had had some years of use, and to compare it with the density it had originally. But who has thought of measuring with the necessary precision the density of such a specimen? Even its origin will be uncertain and its thermal history unknown.

In the great majority of such cases, the new facts to which we alluded will be often mere *impressions*, although sufficiently well grounded to serve at least to orient our thinking.

What then are these facts? Before entering more deeply into this subject, it is necessary to consider what sort of a conception the scientists of today have on the structure of glass. I shall do this in a very elementary manner, leaving certain points for a more precise treatment later.

The isotropic character of its properties, a fundamental criterion of the vitreous state, can be interpreted from a molecular standpoint in two different ways: either the medium is completely lacking in organization, that is to say, that whatever may be the scale at which we make our observations, we are unable to discover a basic scaffolding organized on any such plan as would be found in a crystal fragment, or else the isotropic character is a statistical appearance which depends on the scale of our observations and which, if the latter could only be carried out on a sufficiently small region, would show a recognizable pattern. As a matter of fact, Randall in 1930, studying the diffraction pattern of x-rays, recognized that the faint rings observed with silicate glasses coincided approximately with the spectrum of cristobalite. So was born the theory of crystallites, which has not lost all its advocates and which postulates that glasses were formed by the random juxtaposition of microdomains in whose interior the crystalline pattern of cristobalite predominated.

At this time the theories of the liquid state began to take form and shortly afterwards it was recognized that the blurred bands observed in the spectra were connected with the probability of a given statistical arrangement among its constituents. In 1937, Warren showed that the dimensions of the crystallites could not exceed 7 Ångstrom units, which fact, by reducing the size of the crystallites to molecular dimensions, took away all their meaning.

On the other hand, Warren, analyzing the diffraction spectra, recognized that the first maximum of the spectrum corresponded to an interatomic distance of 1.62 Ångstroms and showed that its area corresponded to a scaffolding or basic structure formed by a silicon atom surrounded by 4 atoms of oxygen. This tetrahedral arrangement was, and has remained, the only thing certain.

By around 1930 also, Zachariasen set forth the second aspect of the theory by supposing that the silicon atom with its high coordination number (4) and its high bonding energy for oxygen (more than 100 calories per gram molecule) could form a three-dimensional network which, given the slight variation of potential energy involved in a small angular displacement of the bond or a small variation in the distance, could offer varying network patterns suppressing any character of periodicity in its construction. A very rough, but none the less convincing, picture, reducing to a two-dimensional diagram what is in fact a three-dimensional matter, involves representing around hexagonal groups triangles standing for the elements of a crystalline network, in groups of 3, 4, 5, 6, 7 and more, of triangles forming the disordered network of the vitreous state.

In this theory it is sufficient to postulate that the figure most often encountered agrees with the figure capable of giving crystalline structure in order to understand the significance of x-ray diffraction spectra.

Figure 1 shows, side by side, a molecular model of cristobalite, the most open structure of silica and one most resembling that of glass, and a model of vitreous silica.

According to this picture, glass appears as an irregular network distorted in orientation and in distance and composed essentially of silicon and oxygen, among whose voids other constituents will take their positions. The excess of oxygen introduced by the oxides of the alkalies and alkaline earths (for ordinary glass the proportion of oxygen to silicon is around 2.5, while that for vitreous silica is 2) does not appreciably modify the validity of this picture. At the end of a linkage, certain oxygens are only attached on the one side to an atom of silicon. It is the electropolarity of such fragments of chains which may be expected to play a role in the ionic bonding of metallic cations. The pseudo-network extends practically without

discontinuity up to the limit of volume studied, and appears as a sort of enormous macromolecule built on an indefinite plan. The statistical isotropy of the bonds could be destroyed by the appearance of an organizing field, as Kantzer has remarked, the ordering due to the field being in a position to involve devitrification.

When the temperature rises, the increasing energy of thermal agitation reaches the energy levels of the weakest bonds. The network dissolves. We thought at one time that when the Boltzmann energy level reached the average value of the bonding energy of silicon to oxygen, one or other of the four bonds of the elementary tetrahedron (with the statistical value which we are giving it) broke, the other three being strengthened: that is to say, that the new distribution of the outermost electrons of the silicon atom corresponded to an increase in the energy of the remaining bonds. The three-dimensional network corresponding to frozen glass was decomposed into two-dimensional networks, distorted and interlaced with one another, in such a manner that the external aspect remained unchanged (solid glass); but the physical constants would be found to have changed (transformation point).

At a higher temperature a new process of breakage of one of the three remaining bonds would come into operation, and the network would become linear. The glass is suitable for the forming of long chains of filaments, in which respect our hypothesis agrees with one of Griffiths'. At a temperature still higher, the final process of rupture reaches the chain-bonds which thereupon break down into wisps of shorter and shorter lengths causing the glass to approach the state of a pure liquid. (It should be noted that above temperatures of 1400°C., the laws of electric conductivity, in particular those of molten glass, approach those of salt electrolytes, pure or but slightly associated.)

This hypothesis has not been confirmed. There is no example of strengthening of bonds originally of a single type, in proportion to the rupture of one bond among several, which would justify the observed temperature spacings. (The successive stages being roughly 550°C., 900°C., 1400°C.)

It is true that in the absence of direct measurements at the temperatures in question, we are unable to proceed except by analogy with the chemistry of low temperatures.

Lillie, Hampton, and others, postulate, when the temperature increases, a degeneration of the network, not by sudden leaps as we have just assayed, but in a gradual, continuous manner; to each temperature there would correspond a state of aggregation having only a statistical significance. The difficulty is the same. It would be necessary to postulate that there are considerable differences of energy level between the first bonds to break at the boundaries of the larger aggregations and the last bonds of the last aggregates which characterize high temperatures. There is nothing in the trifling variations of distance or of angular orientation, which we admit exist in the constitution of the original network, which would permit us to justify such large departures.

However, everyone is agreed that there is at each temperature, as a result of a molecular rearrangement, a structure characteristic of that temperature, whether this structure be the result of an equilibrium between two separate forms, the one stable at high temperature, the other at low temperature (Winter Klein, Gillod), or whether it betrays a state of "pseudo-polymerization" (aggregates of Lillie, Hampton, Seddon). It appears that the difficulty arises from too concrete a picture that one is trying to paint of these molecular arrangements. The concept of bonding, taken in too literal a sense, is at the root of these difficulties. At the borders of covalence and of ionic bonding, do we have the right to sketch rigid tetrahedra? Again, Douglas has attempted to describe the phenomenon we call glass by starting from the theory of the liquid state. The aggregates are replaced by a vague statistical organization, more and more nebulous in proportion as the temperature is raised. Structural modifications under the influence of rising temperature therefore appear to him as indicating simply a more and more disordered spacing of atoms (or of ions), and he reaches without any further hypothesis a reasonably satisfactory explanation of a number of facts.

In all these hypotheses, the idea common to all is that in proportion as the temperature is lowered, the glass tends to take on a structural state characteristic of that temperature, a state which it does not attain except after an elapsed time which is longer in proportion as the temperature is lower.

As a corollary, we may say that if the cooling is sufficiently rapid as compared with the rate of "adjustment" of the structural state, one may attain temperatures sufficiently low (temperatures which leave only thermal agitation as a factor of rearrangement) that the structural state does not "follow" any longer and remains frozen at the point which it had succeeded in attaining in the first stage of cooling.

Having arrived at a low temperature, the glass with its high-temperature constitution frozen in is thermodynamically unstable and must necessarily change, even if it takes an infinite time to do so. It is generally supposed that it is only between the upper limit of the annealing temperature and its lower limit that it is possible to detect the lag of the structural configuration with variations of temperature. On the contrary, the working hypothesis that we shall postulate in order to explain certain everyday phenomena of technical glassmaking is that the thermal history of the molten glass itself, from the very highest temperature attained in the course of the melting down to the softening point, determines the behavior of the future glass. In brief, we postulate qualitatively the notion of lag", seeking to see what consequences this structural lag might have on the fabricating process, leaving till later the experimental proof of this hypothesis.

A.C.S. ANNUAL MEETING

The 53rd Annual Meeting of the American Ceramic Society will be held April 22 through 26, 1951. Headquarters for the meeting will be the Palmer House in Chicago.

The Camera Club, in addition to its usual awards, is opening the competition this year to the wives of A.C.S. members. An award will be given for both the best print and the best colored transparency in the women's group. There will be an entry fee of $1.00 and each wife may submit up to eight prints and eight colored transparencies.

NEW LABORATORY AND RESEARCH FACILITIES AT KNOX

By R. V. YOUNT, Director of Research

Knox Glass Associates, Inc., Knox, Pa.

In keeping with sound business principles and the forward movement of technology, Knox Glass Associates, Inc., Knox, Pennsylvania, has recently moved its Central Laboratory and Research Division into new and expanded quarters. It has long been the aim and hope of many in the glass industry to see more corporation-sponsored projects to increase the basic knowledge of glass and glass making and facilitate production control. Thus, another stone is laid in the foundation of our industry which may, we trust, help to bear the load of an increasing superstructure in this, the oldest manufacturing business in America.

R. V. Yount, Director of Research.

Many years ago the Knox Company, then in an earlier stage of its growth, decided that eventually it would require the laboratory and research facilities necessary to match the progress of the industry. This proposition was discussed at some length in order to find a satisfactory method of approach. Early in 1940 the management began to consider the first stages of this project. Unfortunately, these years, as we all know, were the years leading into World War II and it became necessary for the industrial production of America to be turned to war materiel. As a result, it became impossible for Knox to obtain materials and instruments required for the initiation of this effort. Throughout the war years, however, this idea was kept in mind by the management and finally in 1945, following hostilities' end in Europe and Japan, materials were available to start this Division with the Knox Group of Companies. A temporary laboratory was constructed late in 1945 and was equipped with the latest and best in scientific equipment, and staffed with personnel to get the job started.

Having in mind that this laboratory would be central and would be required to service Knox plants scattered from New Jersey to Colorado and from Illinois to Texas, there was built into this laboratory a large variety of facilities for production control and research These facilities were used for over four years to provide for the Knox Group of Companies a larger measure of control than they had ever before enjoyed, and such facilities were used again and again to aid the Knox companies through difficult times in the raw material market, and in the revision of the entire industry to a new approach to glass manufacture. In recent months the laboratory and research facilities have been moved into their new quarters herein described in order that the job may be carried on in larger measure and with greater ease. The accompanying photographs show in part what has been accomplished in the establishment of these facilities for the use of an organization which during the past thirty-five years has grown to assume the high place it has in glass container manufacture.

For the accomplishment of a well rounded program of production control in the initial phase of the work, it became necessary to develop glass histories, both chemical and physical, to extend and augment the general control analysis which had been made available on an industry-wide basis by certain companies. This, of course, required considerably greater detail than was heretofore readily available in most companies, and it became necessary for Knox to review and revise analytical procedures in order that they might accomplish this purpose with such accuracy as to extend the usefulness of this approach. It became necessary to run complete chemical analyses, evaluating the ingredients of glass, in many cases to a few thousandths of one percent. Likewise, it became necessary to develop and improve methods of examining glass containers in order that the qualities which are necessary to produce a serviceable

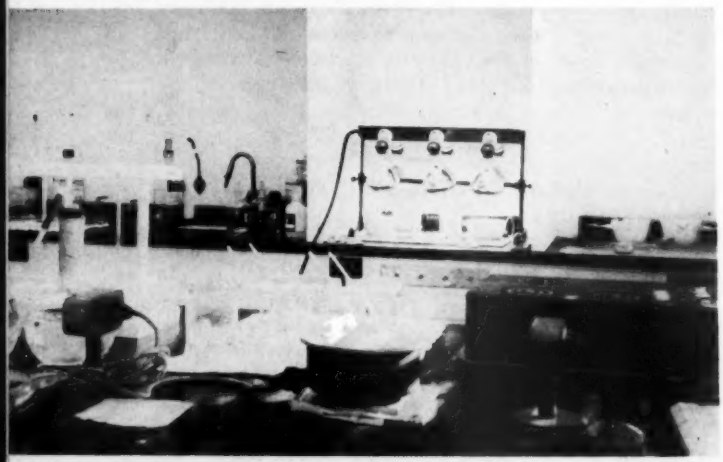
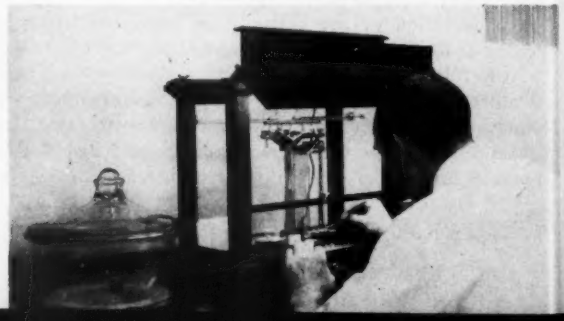


Fig. 1. Special fume hood and bath assemblies.

Fig. 2. R. L. Botts at analytical balance weighing finely ground glass samples.



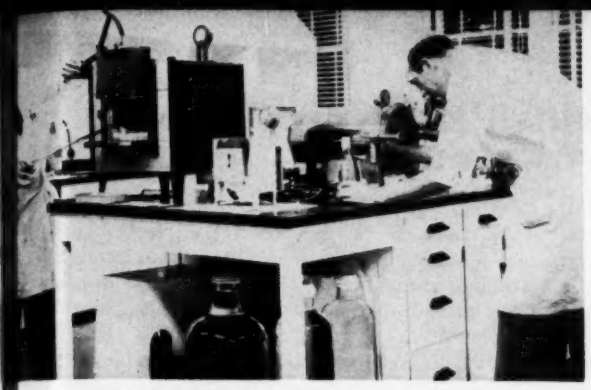


Fig. 3. Sylvester Eibeck at fusion furnace and R. L. Botts at autoclave used in glass solubility work.

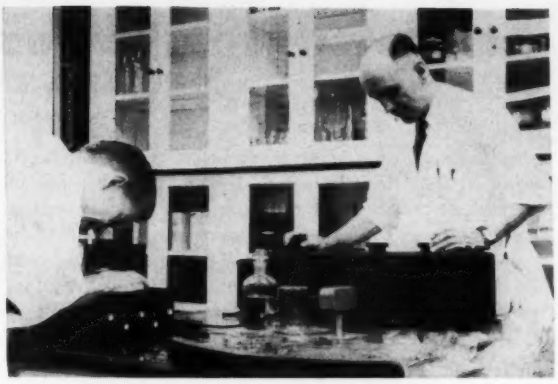


Fig. 4. Cleon Miller and Sylvester Eibeck operating ring section analyzer and Beckmann spectrophotometer.

container could be more accurately determined and plotted for the improvement of both product and operation.

As is well known, the analysis of glass is very involved and the accompanying photograph (Figure 1) shows a part of the specially designed exhaust fume system which is required in order to obtain both accuracy and speed in this work. It became necessary in many cases to construct specially designed equipment to conveniently handle the work. The procedure of glass analysis normally begins with the accurate weighing of finely ground glass samples, as shown in Figure 2, followed by digestion with acids, as shown in Figure 1, or by special fusion as shown in Figure 3. Following this, the ingredients which make up glass are divided in special analytical procedures which enable highly trained personnel to determine the 10 or 15 important ingredients which are occasionally found in glass.

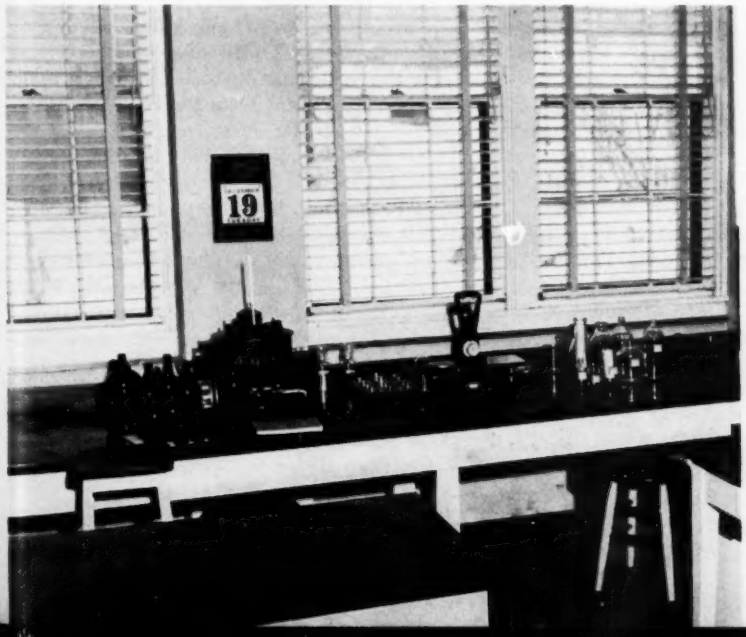
Wherever possible and convenient, electronic equipment has been brought into play, in order to improve the accuracy of chemical analysis work. For example, an electrometric titration outfit is presently being used for the ready determination of an ingredient which previously required a quite involved and messy distillation, which could easily go amiss and produce erroneous results. Instruments are used for the colorimetric determination of other ingredients which occur in small amounts, and it has been found that a substantial amount of time has been saved and an increased accuracy obtained by the use of such equipment. Wherever it was found necessary to streamline an operation in the analytical methods, this has been done. As a result, many highly individual pieces of equipment have been developed and built in the laboratory to accomplish this result. In order to check the various methods of analysis and keep a reliable control system in operation, standard glass samples have been obtained from the Bureau of Standards in Washington for periodic checking on both the personnel and the methods involved. The highly satisfactory results which have been obtained are ample justification of the extreme care with which this program has been set up and followed.

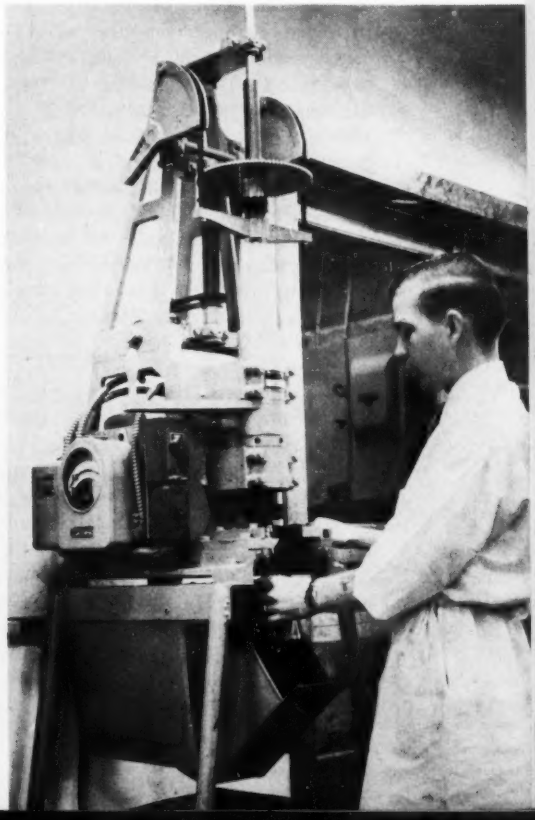
The physical examination of glass involves a great many different steps and Figure 4 shows a part of this,

(*Continued on page* 42)

Fig. 5. (Below) View of some of the physical testing equipment.

Fig. 6 (Right) Single-head Preston hydrostatic pressure testing machine being operated by Mr. Miller.





GLASS SYMPOSIUM AT CHEMICAL ENGINEERS' ANNUAL MEETING IN COLUMBUS

The inclusion of a symposium titled "Chemical Engineering in the Glass Industry" marked a high point in the technical program for the forty-third annual meeting of the American Institute of Chemical Engineers held in Columbus, Ohio, December 3 to 6. The meeting was opened by W. L. McCabe, Flintkote Company, President of A.I.Ch.E. and the attendance was slightly in excess of 1500.

The technical program was widely variant, consisting generally of reports of interesting timely researches. Following the delivery of the Second Institute Lecture by Olaf A. Hougen on the subject, "The Status of Applied Kinetics", the several general technical sessions and detailed symposia were held.

In the general sessions, the discussions included heat transfer, particle packing, filtration and distillation, atomization, and hydrogenation of coal. The detailed symposia consisted of from four to ten papers each, and embraced the following subjects: sonic and ultrasonic power and energy (a continuation of other discussions), phase equilibria relationships for various hydrocarbon systems, and a discussion of correlation methods, the avoidance and combating of air-pollution, including treatment of radioactive gases, and lastly, the mixing, pressure-drop, and heat-transfer characteristics of viscous materials.

The invitational glass symposium was arranged to include papers of interest to the chemical engineers which, in view of the recent increasing uses of glass, would show its role in plant construction, process equipment, and packaging. F. C. Flint, Hazel-Atlas Glass Company and R. A. Miller, Pittsburgh Plate Glass Company presided over the four-paper symposium.

In the first paper, a discussion of refractory problems in the glass industry worked up by C. G. Harman and J. D. Sullivan of the Battelle Memorial Institute was presented by Mr. Harman. He emphasized the fact that all tank blocks for glass melting furnaces are soluble during melting of glass. The chemical reactions of batch melting start as low as 1115°F., and the melt becomes more corrosive as temperature increases. The problem is one of a balance which must be maintained in melting at a temperature high enough to allow the bubbles to rise and escape from the melt, but not so high as to excessively corrode the tank.

In a paper entitled "Chemical Engineering Aspects of Flat Glass, Glass Block, and Foamglas", R. A. Miller used many illustrative slides to good advantage to explain grinding and polishing of plate glass, the drawing of window glass by the Pittsburgh Plate Glass process, methods of melting, storage, and laminating. He also discussed existing hermetically sealed double-glazed units, and showed a sample of P.P.G.'s new all-glass unit. Of further interest were heat-absorbing glass and electrical-conducting glass. He related an important problem in the difficulty of making heat resistant glass flat because of the difficulty of attaining homogeneity in melting. He explained how wire glass retards breaking-out of windows in the event of fire, thus preventing drafts.

In the manufacturing process for block in which the block-halves are flame heated and pressed for assembly, a 100% failure test is given after annealing as part of the production line, after which a plastic is sprayed on the edges to present a surface for adherence of mortar.

In conclusion, Mr. Miller told about the formation and final comparative great strength and good insulation properties of Foamglas.

E. B. Shand of the Corning Glass Works showed curves with accompanying data on the bursting pressure of glass, proving how strength diminishes in static load tests as compared with immediate application of the required bursting pressure. He then showed the advantage of tempering over annealing with additional curves which showed how tempered glass improved strength in a static load test. One interesting illustration was related by Mr. Shand in discussing the inverse relation between thermal and mechanical shock, as regards thickness. If a chemical beaker was made thin enough, it would break easily upon impact, but would survive dropping into ice water after having been raised in temperature to a red heat.

F. W. Preston of Preston Laboratories, who has appreciable modesty about his profound knowledge of the strength of glass, pointed out the discrepancy between the theories which have been advanced concerning the cracking velocity of glass and the actual measured velocity. Dr. Preston stated that the cracking velocity was one mile per second and the velocity of sound in glass was three miles per second. He gave several complicated formulas indicating many possibilities and showed how the theories were variant from the actual measured results.

BULLETIN RELEASED BY DEPARTMENT OF COMMERCE

Mica and mica substitutes are the principal subjects of an industry-military round-table discussion transcript just released by the Office of Technical Services of the U. S. Department of Commerce.

The round-table discussion, held earlier this year under a cooperative arrangement between the Department of Navy and the National Security Industrial Association, included a number of experts of federal and industrial technical organizations. Its purpose was to secure an exchange of opinions concerning late developments in various materials fields of importance to the production of electronic components.

Subjects covered include solid state synthetic mica, glass and vitreous enamel insulating materials, World War II mica research, miniature capacitors, cellulose esters; dimensionally stable ceramics; the use of block talc; integrated mica; and new uses of mica.

Copies of PB 101 142, Mica and Mica Substitutes—Attendance and Transcript of Proceedings, 45 pages, are available from the Office of Technical Services at 50 cents per copy. Orders should be accompanied by check or money order payable to the Treasurer of the U. S.

AUSTRALIAN PROGRESS MIRRORED IN GLASS

By CECIL SLOCOMBE

Sydney, Australia

In this glass-conscious age, Australia is fortunate enough to be self-sufficient in nearly all varieties and phases of glass manufacture. Glass is a £12,000,000 ($27,000,000) business, and glassware is produced locally more cheaply than it can be imported. In production costs, efficiency, and potential, the Australian industry measures up with any country in the world.

Looking at its geographical position so far from the big producing centers of the northern hemisphere, it can readily be gauged how important this factor is in the economy of a nation with a rapidly expanding population of more than 8,000,000 people.

At present domestic use of glassware absorbs all the huge output of Australian factories without leaving a margin for export. Here again global position dictates that the factories must be versatile. Therefore, instead of specializing in one particular product, as is done in most other producing areas, Australia's principal manufacturer, Australian Consolidated Industries, turns out every requirement of the market: bottles, containers, household ware, lamps, window glass, tiles, glass bricks, and so on. This organization, incidentally, accounts for all but a fraction of total Australian glass production and, considered as a whole, it ranks with the major glass manufacturing concerns of the world.

Australia's first settlement took place in 1788 and glass was an early secondary industry. The Sydney *Gazette* of 1813 records that a small "bottle blowing shop" was set up by Simeon Lord at Pyrmont, Sydney (New South Wales). This initial venture failed in its infancy, however, and it was not until 1866 that a real start was made. About that time a firm of wholesaler chemists, Alfred Felton and Frederick Sheppard Grimwade, put up a small furnace in Graham Street, Port Melbourne (Victoria). They were the pioneers of the Australian glass industry. Some English glass blowers were engaged, and later works were established in other cities and in New Zealand. By the early 1900's a dozen or more small factories were supplying an appreciable part of the limited local demand for glass containers.

In 1916 Australian Glass Manufacturer's Company Ltd., was established as the consolidation of certain smaller undertakings mainly engaged in bottle-making. The Australian industry, keeping abreast of the times, began to exploit semi-automatic and then fully automatic methods of glass container production. By 1925, all major plants in Australia had switched almost completely from manual to automatic production.

In the years immediately before World War II, Australian Glass Manufacturers' Company had made such strides that sectionalizing of the industry became necessary. Proprietary companies were formed in 1939 so that they might operate as separate entities. At the same time the name of the parent company was changed to Australian Consolidated Industries, Ltd., and it now operates 18 subsidiary companies.

Swiftly and surely A.C.I. was geared to meet wartime demands. Glass products turned out for the war effort make an impressive catalog: navigation lights, figured rolled glass, floodlight lenses, glim lamps (landing lights), hospital requisites, hurricane globes, signal lamps, Aldis reflectors, Lucas reflectors, wireless valve glasses, serum ampuls, and, of course, food containers by the million, together with many types of receptacles for medical supplies for all branches of the services. The war effort showed how versatile and adaptable were the A.C.I. factories.

When A.C.I. erected new State headquarters in William Street, Sydney, they decided that symbolically it should be largely glass. The frameless glass main door is strong and unsplinterable; it will bend but not break. Looking up at the face of the tall structure, one sees beautiful glass mosaic tiles, used for the first time in Australia on a complete exterior. The tiles were produced only after years of experiment and research. They are not made anywhere else in the southern hemisphere and possibly not in the world.

Cut glass is one of the hundreds of different items coming off the production lines of Crown Crystal Glass Pty., Ltd., an important subsidiary of A.C.I. of Waterloo, Sydney. In at least some respects the Australian product is considered the equal if not the superior of the imported article. Output, however, is fairly limited at the present time. The factory has by far the greatest turnover in the more homely field of the plate, cup and saucer, milk jug, salad bowl, and other pieces required for the kitchen or for decoration.

For raw materials, A.C.I. mines and treats its own silica supplies at Longwood, South Australia, and it works its own feldspar mines at Coolgardie, Western Australia. Before the Coolgardie deposits were taken over, all feldspar was imported. It has since been found that the Australian product is equal to any.

Work in Australian factories is governed by Arbitration Court awards. When qualified to operate his own machine, after some initial weeks of personal tuition, a workman becomes eligible for bonuses on production. In the bottle plants (the major part of the industry), rotational shifts are maintained, the working week being 40 hours a man. Window glass is turned out continuously, 21 shifts a week (seven days of three shifts each). Employees in this factory mostly work three weeks of 40 hours, followed by one week of 32. Glass factories of A.C.I. at mid-1950 were employing a total of 8,100 hands. The area covered by the various factories is about 140 acres.

Glass is produced at all mainland capital cities (Sydney, Melbourne, Brisbane, Adelaide, and Perth) with a factory about to be opened at Hobart, capital of the island State, Tasmania. The Australian group also maintains overseas factories at Auckland (New Zealand) and Singapore, while another is in prospect at Christchurch, in the South Island of New Zealand. There are overseas offices in London (England) and Pittsburgh (U.S.A.).

Singapore's output, strategically placed in the clearing house of the East, compensates in a measure (as does New Zealand's) for the current inability to meet an ex-

(*Continued on page* 46)

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of five papers which appeared in the Russian journal of the glass and ceramic industries.

AN EMPIRICAL FORMULA FOR THE VISCOSITY OF GLASS

M. V. Okhotin, in *Steklo i Keramika* (Glass and Ceramics) 7, No. 5, 6 (1950), recommends an empirical formula for calculating the viscosity of glass at different temperatures, if this viscosity (η) is known for three temperatures. The formula is

$$\log \eta = a + \frac{b}{t^n};$$

t is temperature in degrees centigrade, and a, b and n are constants which must be determined by (at least) three experiments.

For instance, a glass of the composition SiO_2 70.54, Al_2O_3 2.12, CaO 7.75, MgO 3.06, Na_2O 15.93 and SO_3 0.6% had log a = 3.1623, b = 12208600, and n = 2.1789; the temperature range of validity of this equation was 895-1300°C. A lead silicate SiO_2 28.75, PbO 71.25% had log a = 0.39038, b = 1083840, and n = 1.88372 between 740 and 1340°C. A sodium silicate SiO_2 64.4, Na_2O 35.6% had log a = 0.017722, b = 12828, and n = 1.1446 between 760° and 1420°C. Viscosity is in poises (i.e. g./cm. sec.).

MANUFACTURE OF SHEET GLASS WITHOUT DEBITEUSE IN U.S.S.R.

The bulk of sheet glass in U.S.S.R. is produced by the Fourcault method, but two glass plants started production without debiteuse in 1949 and 1950, respectively. I. I. Ben publishes some information on this process in *Steklo i Keramika* (Glass and Ceramics) June 1950, p. 1. No complete description of the process is given, however, and it is not compared with the similar methods used outside U.S.S.R. (The method is styled "the new Soviet method of withdrawing glass sheet from a free surface").

The glass composition had to be changed when new machines were substituted for Fourcault units. Table I shows both compositions.

Table I

Composition of glass for Fourcault machines and machines without debiteuse.

	with debiteuse	without
SiO_2	71.30	71.88
R_2O_3	0.90	0.86
CaO	7.80	7.86
MgO	3.41	3.49
SO_2	0.56	0.56
Na_2O	16.00	15.24

The rate of withdrawal was smaller than before, but should be raised when more experience is available. The rate was for Fourcault machines, 50, 42, 32, and 31 meter/hour for the four standard sheet thicknesses (not specified), and without debiteuse, 40, 35, 32, and 32 meter/hour for the same thicknesses.

The duration of work before the sheet broke off was longer than in the Fourcault process. In one instance it reached 421 hours.

The daily production was 7000 sq. meters without and 82000 sq. meters with debiteuse, but the order would be reversed, if the figures were corrected for different sheet thicknesses; the corrected values are 11600 sq. meters without and 11200 sq. meters with debiteuse.

However, the main advantage of the new method was in the improvement of quality. The percentage of first class goods increased from 24 to 47%, that of second class goods decreased from 29 to 20%, and that of third class goods from 47 to 33%.

The coefficient of utilization of the glass mass was 0.74 with and 0.73 without debiteuse. The main reason for the imperfect utilization of glass without debiteuse was poorly shaped edges of the glass sheet which often made necessary cutting off wide margins.

It is expected that the new method will increase the profit by (a) raising the quality (and the price) of glass, (b) reducing the time lost on starting a new ribbon of glass, (c) eliminating the expense on debiteuses, and (d) lowering the amount used of the expensive sodium carbonate.

HARDENING OF THIN WINDOW GLASS

The standard Russian window glass for automobiles and busses is 6 mm. thick. Recently, glass of 4.5-5 mm. thickness was introduced. It could not be hardened in the conditions used for the thicker glass. Z. I. Bronshtein, *Steklo i Keramika* (Glass and Ceramics) 7, No. 5, p. 8 (1950), describes the simple alterations of the procedure, which proved satisfactory for the thinner glass.

In the standard apparatus the distance between the air nozzles and the glass sheet is 90 mm. This distance was reduced to 55, 40, and finally to 30 mm.; this increased the degree of hardening, expressed as the optical path difference (in wave length) per cm. of the thickness of the sheet, to 1.8, 2.5-2.6, and 2.9-3.0, respectively. The samples subjected to hardening were 100 x 200 mm. big. They were heated to 650°C. for a time equal to 40 d sec., if d is the thickness of the sheet in mm. (i.e. for 180-200 sec.), and then cooled in a blast of air compressed to 22 mm. Hg.

Similar treatment was accorded to samples of 240 x 240 mm., and these samples were tested for strength. In the bending test, 80% of the samples cooled from 55 mm. distance broke when the stress was 1650 kg./sq.cm. or less, while 80% of the samples cooled from 40 mm. or 30 mm. distance broke when the stress was 1900 kg./sq.cm. or less. Out of 100 samples hit by 780 g. ball from 1.5 m. height, 11 survived if the samples were cooled from 55 mm. distance, while the number of survivors was 22 and 32 for the samples cooled from 40 and 32 mm. respectively. The percentage of small fragments (less than 10 mm. in any direction) was 0%,

33%, and 80% for the distances 55, 40 and 30 mm, respectively.

Samples cooled from 30 mm. and 40 mm. satisfied the Russian requirements for windshield glasses.

VISCOSITY OF A GLASS BETWEEN 680 AND 844°C.

When the viscosity of a glass has a value between 10^6 and 10^8 poises, it is particularly difficult to measure. The method of elongation of fiber, which is well suitable for the greater viscosities, cannot be used, as surface tension acts against gravity and may cause contraction of the fiber rather than its elongation. M. V. Okhotin and R. I. Tsoi, *Steklo i Keramika* (Glass and Ceramics), June 1950, p. 13, claim to have circumvened this difficulty by using, instead of the fibers, rods provided with blobs at the bottom end. If P is the weight of the bottom half of the specimen then for viscosity η the following equation is used:

$$\eta = \frac{P\, l\, z\, g}{3\, s.\, \triangle\, l};$$

l is the length of the specimen, s its cross-section, $\triangle\, l$ is elongation during the time z, and g is the acceleration due to gravity.

A glass of the composition SiO_2 75, Na_2O 16, CaO 5, MgO 3, Al_2O_3 1 was used. The results obtained are:

Temp. °C	Viscosity in g/cm.sec.
844	316×10^3
792	264×10^4
755	112×10^5
718	466×10^5
680	215×10^6

REACTION BETWEEN SODIUM HYDROXIDE AND QUARTZ SAND

M. A. Khachvankyan, *Steklo i Keramika* (Glass and Ceramics), June 1950, p. 8, published a study of the reaction between molten sodium hydroxide and quartz sand, as a contribution to understanding the process of glassmaking. Unfortunately, this study has been carried out at temperatures (300°-900°C.) far below those obtained in glass furnaces, and the main conclusion of Khachvankyan cannot be valid in industrial glass melts.

This conclusion is that sand grains dissolve in molten sodium hydroxide until the sodium silicate layer formed in this reaction becomes so thick that virtually no diffusion across it is possible and any contact between sodium hydroxide and quartz ceases.

Three sets of observations led to the above conclusion.

(1) When a mixture of sand and NaOH was heated above the melting temperature of NaOH, a reaction (visible because of formation of water vapor) started but continued for a few minutes only. Additional heating for many hours did not increase that amount of SiO_2 which became soluble in water. For the equimolecular ratio of Na_2O:SiO_2 and quartz grains of 0.3-0.4 mm., the percentage of sand dissolved was 54% at 320°, 63% at 500°C., 74% at 600°C., and 82% at 800°, i.e. increased with temperature.

(2) The percentage of sand dissolved increased when the particle size of the sand decreased. At the ratio Na_2O:SiO_2 greater than 1.2 and 700°C., very fine particles (diameter below 0.074 mm.) were completely transformed into sodium silicate, while undissolved sand remained as long as the particles were large.

(3) The number of quartz grains, if they were large, remained unchanged during the reaction, while the average size of the grain decreased.

Apparently, reaction between SiO_2 and NaOH ceased when the protective layer of Na_2SiO_3 was about 0.08 mm. thick.

J. C. HOSTETTER TO RECEIVE BLEININGER AWARD

The recipient for the Albert Victor Bleininger Award of 1950 has been named as Dr. John C. Hostetter, long time Corning Glass Works scientist and recent President of the Mississippi Glass Company.

The announcement was made at the December meeting of the Pittsburgh Section of the American Ceramic Society. The award is conferred for "distinguished achievement in the field of ceramics" and is given annually to an outstanding man in ceramics. Presentation of the award, symbolized by a medal and scroll, will be made at a testimonial banquet at the Hotel Schenley in Pittsburgh on March 16, 1951.

Dr. Hostetter has been for many years a prominent administrator and executive in ceramics. Born in Williamsport, Pa., in 1886, he received his B. Sc. degree from Bucknell University in 1908, his M. Sc. in 1909 from the same university, and has been honored by doctorates at Bucknell and Alfred Universities.

During his career, he has been associated with the National Bureau of Standards, the Geophysical Laboratory of The Carnegie Institution of Washington, and was Director of Research and Development at Corning Glass Works during the period in which the famous 200-inch mirror for the telescope at Mt. Palomar, California, was cast. Later Dr. Hostetter served as Vice President and Director of Research for Hartford-Empire Company, and was President of the Mississippi Glass Company. He recently retired and is now residing in Winter Park, Florida.

Dr. Hostetter has served on technical committees in various fields of science and is a member of many societies, including the American Chemical Society, American Society for Testing Materials, American Institute of Chemical Engineers, and British Society of Glass Technology. A Fellow and Trustee of the American Ceramic Society, he served as its President in 1933. In 1937 he was awarded the Howard N. Potts Medal by the Franklin Institute for his combined technical understanding and executive ability in directing the application of glass to new, diversified uses. Dr. Hostetter is the fourth recipient of the Bleininger Award.

ANCIENT ASIATIC GLASS STUDIED IN TOLEDO

Distinctly apart from ancient Egyptian and Mediterranean glass, about which much is known due to the large amount of investigation which has been possible in the past concerning it, is the mystery-shrouded glass of antiquity which has been discovered in different localities in the whole of Eastern Asia. Apart from a limited amount of work done by some English and Swedish archeologists, identification and establishing the chronology of this glass has not been exactly an overcrowded field. For that reason, it is attractive to a few hardy souls who have the patience to be satisfied with a limited amount of investigation material to work with, and who are content to make reliable conclusions only at widely-separated intervals and after much research.

Such a person is Miss Dorothy Blair, Assistant Curator Emeritus of the Toledo Museum of Art. Since her recent retirement from the museum staff, where she was in charge of oriental art in general, she has devoted most of her available time to the study of this East-Asiatic glass. Her previous experience included a year of study at Kylto Imperial University in Japan, and travel which was limited to Japan, Korea, and Manchuria due to war in China at that time.

Available at the Toledo Museum of Art for study are samples of historic Asiatic glass from all periods of significant change in the type of glass manufacture and articles produced. The earliest known Asiatic glass was found in China and dates from the 4th or 3rd century B.C. Characteristic articles are ingeniously made glass-inlaid beads, which were found in graves of the wealthy or persons of royalty. In the following five or six hundred years there were produced, in addition, ceremonial objects and figures, pendants and girdle ornaments, but no blown items. Objects dating from this same period have also been found in Korea.

Miss Blair explains that at the conclusion of this period, the Chinese glassmaking art seemed to have been forgotten, because it died out. The next record of any glassmaking activity seems to be in the fifth century of the Christian era when, according to records, the Syrians brought the art of glassmaking to the Chinese which, despite the previous activity, seemed to be a process which was entirely new to them. Articles produced in this and the subsequent era include plates, bowls, and blown bottles. Intermittent production of glass continued in China, although the dating of pieces found has been difficult and nebulous.

Once again in the 18th century there is record of glassmaking techniques having been brought into China, this time by the Jesuit Missionaries, in what again seemed like something entirely new to the Chinese. Glass production again flourished, and many pieces representative of this era have been found. In addition to plates, decorated bottles and vases, glass was used to reproduce intricately carved jade and other precious stones, so that glass became the poor man's jewelry. Several interesting objects have been disclosed from Japanese culture also.

Miss Blair explains that the biggest problem in solving the riddle of what belongs where is to be able to accurately date the period to which questionable objects are associated, and also to determine whether an object is native to the area in which it was found, whether it was imported, or whether it is a planted imitation. Whereas formerly about the only reliable information was obtained from shopkeepers who handled items after they were plowed or dug up in a certain area, now scientific investigation parties explore and systematically excavate important discoveries.

In the interest of properly identifying the questionable items now available in Toledo, Miss Blair is attempting to muster all forces to assist in examining and analyzing them. Chemical analysis helps greatly in associating objects from the same periods, and testing the physical properties with heat, polarized and ultraviolet light, and the microscope help to distinguish confused markings and to separate imitations and items made from pure minerals. Much additional reliance may of course be placed on the comparison of decorations and art forms on the glass with those on other art objects, especially in the later periods. Also, literary researches are fruitful, except that most of the existing records are written in Japanese.

Miss Blair is not only acting as a leader in trying to solve existing enigmas by having accurate analyses made, but she would like to resume her study of Japanese so that she could fathom the secrets about glass held in the original writings. More power to her!

NATIONAL SAFETY COUNCIL ISSUES TRAINING BOOKLETS

Six new training booklets for foremen and supervisors, called the "Psychology of Safety in Supervision", have just been issued by the National Safety Council. The series was written by Dr. J. L. Rosenstein, industrial psychologist and professor in the Department of Management, Loyola University.

"You Can't Change Human Nature" is the title of the first booklet which discusses common peculiarities of human nature and explains why no one is perfect. "What Is Your U Q?" explains the meaning and importance of a supervisor's "understanding quotient". Booklet number three, "Teaching Safety on the Job", describes accidents that happened because workers lacked sufficient knowledge or skill and discusses supervisory training methods required to prevent such accidents.

"People Act Alike", the fourth booklet, explains in what way normal people are alike and in what manner they differ from one another. It discusses basic human wants and explains how supervisors can satisfy these wants. The fifth booklet in the series, "Safety Takes Teamwork", suggests methods for supervisors to make safety interesting and important to workers. "You Are Human, Too", the last booklet, gives supervisors a hypothetical measuring stick for determining their own strong points and weaknesses, and shows them how to evaluate their habits, emotional biases, and abilities.

BOOK REVIEWS

Modern Refractory Practice

This is the third edition of a compilation of refractory information presented by one of the leading refractory manufacturers, Harbison-Walker Refractories Company.

The new 440-page volume is a practical engineering handbook, a comprehensive technical treatise, and a catalogue of the company's products. While it follows the general lines of the second edition published in 1937, the book has been completely rewritten and has been increased from 296 to 440 pages.

Scale drawings of twenty types of furnaces, illustrating up-to-date industrial practice, constitute one of the important features of the book. The drawings show in detail not only the design of the furnaces, but also the types of refractories generally used and, in some cases, they also show alternate types for special conditions of operations. There is a discussion of the service conditions and requirements for refractories in furnaces of a wide variety.

A chapter is devoted to suggestions of a practical nature regarding the selection, care, and use of refractories, including handling, installations, and service factors which affect the life of refractories. Another chapter contains a discussion on arch construction and design, placement of skewbacks, calculation of arch stresses, and design of arches of high rise.

The chapter on the properties of refractories consists of two parts. The first is devoted largely to a discussion of the mineralogy of refractories, and to stability relations at high temperatures. The second part pertains to the physical and chemical properties with special reference to those which have greatest significance with regard to the utility of refractories. This chapter contains considerable material not previously published.

The new book is offered by Harbison-Walker Refractories Company, Pittsburgh, Pa., without charge to users of refractories, to libraries, and to heads of departments in universities and technical schools. For general distribution or for student use, a small charge is made.

Mineral Industries Education

By Edward Steidle

Tracing the history of the establishment and development of the School of Mineral Industries of Pennsylvania State College, Dr. Steidle, Dean of the School, has gathered together in one volume Circulars 31, 33, and 35 which were published in 1948, 1949, and 1950 respectively.

Circular 31, "Roots of Human Progress", was a consideration of the part man has played in regard to utilization or waste of the resources at hand, the aspects of his influence on nature and on his fellow man, and how he has progressed and might further progress. Circular 33, "A Philosophy for Conservation", presented a plan for world-wide, unified conservation of human and material resources and inquired where we stand on ten great conservation issues. Circular 35, "Wanted: Mineral Industries Colleges", offered an effective, working program for training mineral scientists and technicians, men aware that all reactions taking place in nature occur according to the immutable laws of nature, men who might devise a solution for the ills of the world according to the patterns of nature. This circular also disclosed the story behind Pennsylvania's School of Mineral Industries, the progress in shaping courses in mineral arts and sciences with the premise that while there might be human progress without civilization, there can be no permanent civilization without conservation and no conservation without education.

The volume presents a 20-year report of the school, a blueprint that will be followed, if correct, or changed from time to time if necessary.

Available through Mineral Industries Extension, State College, Pa.; 252 pages; Price $3.00.

The Condensed Chemical Dictionary

Edition Revised and Enlarged by
Professor and Mrs. Arthur Rose

The fourth edition of the Condensed Chemical Dictionary is a completely revised, up-to-date, and enlarged reference book. There is an addition of 5,000 new items to the previous edition, which makes a total of over 23,000 items.

Included is data on the chemical and physical properties of chemicals and raw materials. The popular information on containers, shipping regulations, and safety instructions has been continued and brought up-to-date. Many new items have been added in such fields as nuclear chemistry, chemotherapy, petrochemistry, etc. New cross references have been added and many of the new chemicals listed have just completed the pilot plant stage of development to be placed on the market shortly.

Published by Reinhold Publishing Corporation, 330 West 42nd Street, New York 18, New York; 721 pages; Price $10.

L-O-F APPOINTMENTS

Henry M. Dodge, co-plant manager of the East Toledo plants of Libbey-Owens-Ford Glass Company, has been promoted to manager in full charge of all East Toledo operations, according to an announcement by Curtis W. Davis, Vice President of the firm. Mr. Dodge succeeds to the position held by Joseph P. Crowley who retired effective December 1.

Mr. Dodge joined L-O-F at the laminating plant in 1932. During World II he was in charge of the special wartime Plexiglas plant at Rossford but returned to become manager of the laminating plant in 1943. He was promoted to co-plant manager of East Toledo plants in 1948.

Mr. Crowley, who has been associated with the company since 1919, has been in the glass business in Toledo for nearly 40 years, having helped Michael Owens perfect the Colburn window glass machine which was the basis for formation of the Libbey-Owens Sheet Glass Company, predecessor of L-O-F.

At the same time Mr. Davis announced the promotion of Henry W. Schult, product manager, to assistant manager of the East Toledo plants, and promotion of C. A. Miller, Jr., general superintendent of the plate plant, to production manager of the East Toledo plants. Mr. Schult has been with the firm for 22 years and was promoted to production manager of the two East Toledo plants in 1948. Mr. Miller joined L-O-F in 1940 and was promoted to general superintendent in 1948.

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Furnaces

Batch Feeder. Fig. 1. Patent No. 2,533,826. Filed June 10, 1947. Issued Dec. 12, 1950. Two sheets of drawings. Assigned to Hartford-Empire Company by Aaron K. Lyle.

Water cooled pipes 20 and 21 carry a rabble 22, also water cooled, which is moved in the path indicated by dotted lines by mechanism driven by the motor 6. The pipes are pivoted on a link 13. The rabble dips into the molten glass and pushes the batch delivered from a hopper 47 and a chute 45 forward from the doghouse into the furnace.

The patent contains five claims and the references cited by the Patent Office were 1,201,664, Williams, Oct. 17, 1916; 1,361,853, Hazel, Dec. 14, 1920; 1,483,278, Carey, Feb. 12, 1924; 1,560,070, McNamara, Nov. 3, 1925; 1,594,799, Smith, Aug. 3, 1926; 1,953,221, Good, Apr. 3, 1934; 2,281,050, Redshaw, Apr. 28, 1942; and 2,294,373, Batchell, Sept. 1, 1942.

Glass Compositions

Colored Phosphate Glass. Patent No. 2,532,386. Filed Sept. 27, 1949. Issued Dec. 5, 1950. No drawings. Assigned to Corning Glass Works by William H. Armistead.

This glass is particularly adapted for use in photronic cells. It is distinguished by including in the composition 0.1% to 3% CeO_2. The patent gives 10 compositions coming within the scope of the invention, calculated from their batches to the oxide basis in per cent by weight, as follows:

	1	2	3	4	5	6	7	8	9	10
P_2O_5	61.1	67.5	68.2	65.6	62.2	60.5	55.7	62.6	66.3	62
Al_2O_3	15.4	16.8	17.1	16.5	15.6	15.1	13.9	15.7	16.5	15.5
SiO_2	19.5	14.9	4.7	4.9	9.2	9.4	8.4	14.7	15	14.5
CuO	1	0.5	3	2	5	4	1.5	1	0.1	1.3
CeO_2	0.5	0.3	2	1	3	1	0.5	1	0.1	0.5
Na_2O	—	—	—	—	—	—	—	—	2	—
Li_2O	—	—	—	—	—	—	—	—	—	0.1
CaO	—	—	—	2.5	—	—	—	—	—	—
ZnO	2.5	—	5	2.5	—	—	10	—	—	2.5
BaO	—	—	—	—	5	—	—	—	—	2
PbO	—	—	—	—	—	—	—	5	—	1.6
B_2O_3	—	—	—	5	—	10	10	—	—	—

The above compositions are suitable for melting in closed pots and composition 10 is particularly useful for the purpose of the invention.

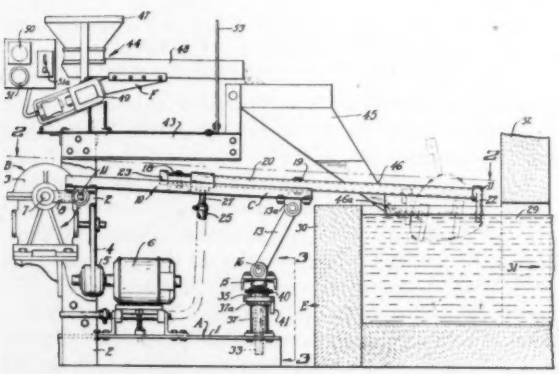


Fig. 1. Batch Feeder.

The patent contains eight claims and no references were cited by the Patent Office.

Tube and Cane Machines

Glass Severing Machine. Patent No. 2,530,511. Filed Feb. 16, 1948. Issued Nov. 21, 1950. 11 sheets of drawings, none reproduced. This patent is the latest of a large number of patents granted to Edward Danner of Newark, Ohio.

The machine provides for cutting the tube or cane into desired lengths as it is drawn from the furnace. A scoring tool moves with the glass and makes a score mark which determines the break when lateral pressure is applied to the glass. Grippers produce a lineal pull in excess of the speed at which the glass is traveling when the break is made. This produces a clean square break much better than it has been possible to accomplish by prior machines. The machine is fully adjustable to accommodate glass of different sizes and different speeds of drawing.

The patent contains 13 claims and 11 references were cited by the Patent Office.

Tube Drawing Machine. Fig. 2. Patent No. 2,532,091. Filed Feb. 13, 1948, in Great Britain Feb. 18, 1947. Issued Nov. 28, 1950. Five sheets of drawings. Samuel J. Everett, Thornton, England, inventor.

The machine comprises means for supporting a glass tube 6 which is to be drawn to an accurate size as it passes through a small furnace 5. Inside the tube there is a refractory mandrel 8 carrying spaced carbon rods 9 which serve to centralize the tube. The nose 8A of the mandrel is tapered to size desired in the finished tube and it is coated to prevent sticking with graphite or other lubricant. The inside of the mandrel is connected to a source of vacuum which opens to the tube through a port 48. The mandrel can be rotated continuously or reciprocated axially or both. As the hot tube is drawn over the mandrel, it is reduced to an accurate size.

The patent contains 13 claims and the references cited were 1,301,714, Kueppers, Apr. 22, 1919; 2,393,979, Everett, Feb. 5, 1946; 2,396,254, Everett, Mar. 12, 1946; 339,503, Germany, July 26, 1921; and 547,880, Great Britain, Feb. 8, 1941.

Miscellaneous Processes

Tempering Glass. Fig. 3. Patent No. 2,525,112. Three sheets of drawings. Assigned to Hartford-Empire Company by T. C. Baker. This patent shows a method of tempering concave-convex lenses or mirrors and a machine for carrying out the method.

The machine comprises a heating furnace 11 and a

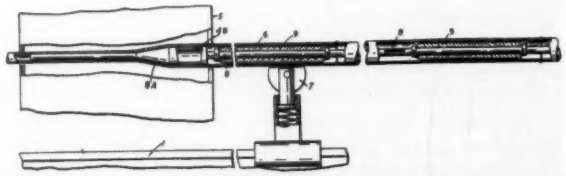


Fig. 2. Tube Drawing Machine.

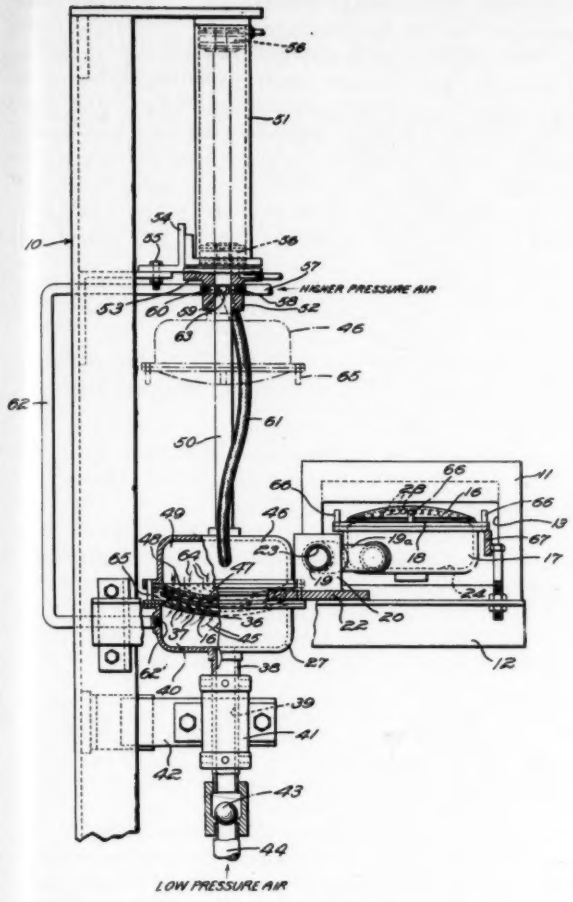


Fig. 3. Tempering Glass.

head 17 shaped to fit the concave surface of the work. A handle is provided by which the head with the heated lens may be inverted and moved to deposit the lens over a cooling head 27 having low pressure air discharging through numerous holes. An upper cooling head 46 supplied with high pressure air is moved toward the lower head but spaced from it so that the lens floats on air between the two heads. The lens is held on the head 17 during invertion by suction.

The patent contains 11 claims and 13 U. S. patents and 9 foreign patents were cited by the Patent Office.

Method of Treating Bottles. Fig. 4. Patent No. 2,525,725. Two sheets of drawings. Assigned to Wheaton Glass Company by Nelson J. Rodman.

This patent provides for treating bottles with an acidic gas, such as SO_2, while passing through a lehr requiring little change from those in regular use. The lehr shown in the figure is of the usual type about 60 feet long through which the bottles pass in about two hours. The lehr comprises a preheating chamber 16 and by the time the bottle reaches a gas chamber 17, its temperature has been brought to about 850 or 900°. The gas chamber is separated from the rest of the lehr by curtains 18 and 20, and SO_2 is delivered to the chamber by a diffusor pipe 23. By the time the bottle leaves the chamber, its temperature has been reduced to about 650°. This reduces the volume of air in the bottle and thus draws SO_2 into the bottle.

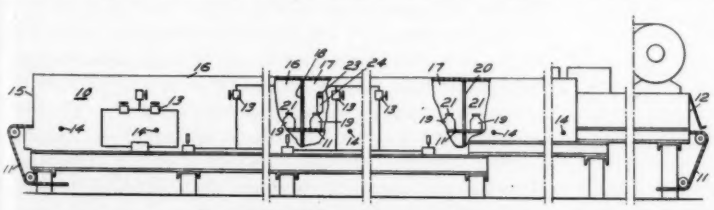
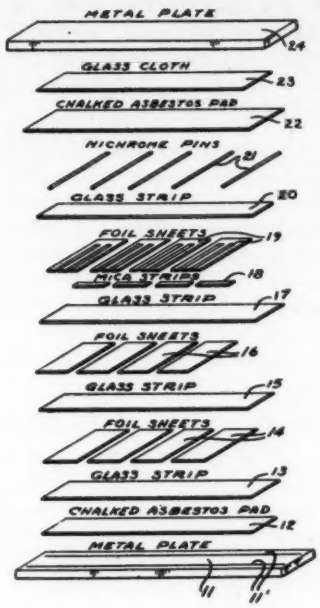


Fig. 4. Method of Treating Botles.

The references cited by the Patent Office were: 1,782,169, Kamita, Nov. 18, 1930; 1,809,534, Tillyer et al., June 9, 1931; 1,933,529, Wardley et al., Oct. 31, 1933; 1,973,501, Murgatroyd, Sept. 11, 1934; 2,056,207, Piazzoli, Jr., Oct. 6, 1936; 2,203,182, Rendall, June 4, 1940; and 2,241,511, Greene, May 13, 1941.

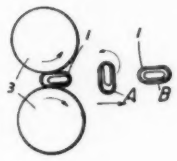
Electrical Condensers. Fig. 5. Patent No. 2,526,703. Filed March 3, 1944. Issued Oct. 24, 1950. One sheet of drawings. Assigned to Corning Glass Works by Gail P. Smith. The patent relates particularly to a method of separating a thin sheet of glass into a number of sections to be incorporated into a condenser.

The figure shows an exploded view of the parts to be passed through a furnace. The parts thus assembled are passed through pressing rollers and then through a furnace where the glass is brought to a point near its soft-



Left: Fig. 5. Electrical Condenser.

Below: Fig. 6. Flattened Glass Tubing.



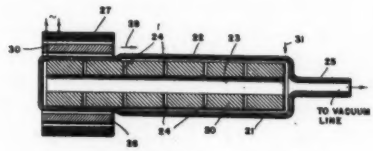


Fig. 7. Forming Glass Tubing.

ening temperature. After passing through an annealing section, the strip is separated into individual condensers by thermal shock producers by passing an electric current through the wires or pins 21.

Eleven references were cited by the Patent Office.

Electrical Condensers. Patent No. 2,526,704. One sheet of drawings none reproduced. Assigned to Corning Glass Works by George J. Bair. The drawings and specifications of this patent are substantially identical with the Smith patent above and the filing and issue dates are the same. The patent discloses further details in the method of manufacturing the same article but by a different inventor.

The patent contains four claims and 12 references were cited by the Patent Office.

Enamel for Sheet Metal. Patent No. 2,526,299. Filed Feb. 13, 1947. Issued Oct. 17, 1950. No drawings. Assigned to National Lead Company by Stanley G. Tinsley, Billingham, England.

This patent relates to a vitreous enamel coating for use on sheet metal. It gives three examples of frit coming under the patent with full directions for practicing the method. The patent contains four claims, the first being as follows: A method of preparing, from a white enamel frit, a liquid suspension for use in vitreous enamelling, which consists in suspending the frit particles in a compound inorganic gel formed by the reaction of solutions of sodium silicate containing a ratio of Na_2O to SiO_2 within the range of 1:1 to 1:4 and sodium aluminate.

The references cited were 2,085,129, Stoewener, June 29, 1937; 66,065 Germany, 1892; and Ceramic Industry, Jan., 1944, pp. 103-104.

Glass Batch. Patent No. 2,527,618. Filed Sept. 29, 1945. Issued Oct. 31, 1950. No drawings. Michael J. Bozich, inventor.

This batch contains an ingredient to prevent caking prior to use. The invention is defined as a new composition of matter, an intimate mixture of a glass making material of the group consisting of borax, boric acid and sodium nitrate, and from approximately 0.25 to 1.5 per cent by weight of pumice subdivided to pass a 325-mesh screen, the mixture being free flowing and resistant to caking.

The patent contains two claims and 11 references were cited by the Patent Office.

Glass Welding Method. Patent No. 2,527,720. Filed Dec. 18, 1946. Issued Oct. 31, 1950. One sheet of drawings, none reproduced. Assigned to Corning Glass Works by Edwin M. Guyer.

This patent covers the method of welding pieces of glass together by coating at least one of the adjoining edges with a conducting iridized film comprising stannic oxide and passing current through the coating until the glass is heated so that it becomes a conductor after which the heating current is passed through the glass.

The patent has one claim and the references cited were 2,021,661, Kisfaludy, Nov. 19, 1935; 2,119,680, Long, June 7, 1938; 2,258,646, Grisdale, Oct. 14, 1941; 2,429,420, McMaster, Oct. 21, 1947; and 767,797, France, July 24, 1934.

Treating Glass Containers. Patent No. 2,528,391. Filed April 27, 1948. Issued Oct. 31, 1950. No drawings. Eric Seddon, London, England, inventor.

This patent aims to improve the durability of the interior of glass containers which has in the past been done by treating the surface with burning sulphur which liberated an acidic gas. This patent shows how to obtain a better result by introducing a pelleted mixture of ammonium sulphate with ammonium chloride into the container and effecting a decomposition therein of said mixture, the mixture containing 90 to 97 per cent of ammonium sulphate.

The patent contains three claims and the references cited by the Patent Office were 1,760,427, Matlock, May 27, 1930; 2,053,066, Cunningham, Sept. 1, 1936; 2,081,401, Kniskern, May 25, 1937; 2,175,076, Burch, Oct. 3, 1939; 2,184,320, Simpson, Dec. 26, 1939; and 2,436,771, Hood, Feb. 24, 1948.

Machine for Sealing Ampuls. Patent No. 2,529,109. Filed Oct. 29, 1946. Issued Nov. 7, 1950. Three sheets of drawings, none reproduced.

This invention by Walter A. Shields discloses a machine for sealing the open ends of vials or ampuls. The machine is of the straight line type as distinguished from the turret type. A carrier takes the work through a number of stations where it is heated and then sealed. Apparently this machine has numerous advantages over those previously used.

The patent contains 18 claims and the references cited were 2,224,486, Richter, Dec. 10, 1940; 2,258,408, Cozzoli, Oct. 7, 1941; 2,270.152, Themak, Jan. 13, 1942; and 551,599, France, Apr. 9, 1923.

Method of Making Beads. Patent No. 2,524,613. No drawings. Assigned to Cataphote Corporation, Toledo, Ohio, by Eugene Wainer. The patent relates particularly to beads having a diameter of from .010″ to .070″ as used in reflecting paints, although larger and smaller sizes may be made by the same method. This patent is an improvement over the patent to Davis et al., No. 2,460,977.

The patent contains 14 claims and the invention is defined in the last of these as a method of making glass beads, which comprises intimately mixing finely divided glass cullet with an isolating medium consisting essentially of boron nitride and minor amounts of inert diluents, said isolating medium being present in such amounts that the boron nitride therein comprises at least 50% of the total isolating medium-glass cullet mixture, heating the mixture of isolating medium and glass cullet until the glass particles form beads, and separating the isolating medium from the beads.

No references were cited by the Patent Office.

Lamp Sealing Machine. Patent No. 2,525,043. Two sheets of drawings, none reproduced. This is a joint invention by five inventors and it was assigned to General Electric Company.

The machine is of the turret type and has 16 working stations. A tube for a fluorescent lamp is positioned in a head at the first station and as the head travels half way around the machine a flared mount is sealed to the lower end of the tube. On the opposite side of the machine another operator reverses the tube and the same operations are performed to complete the sealing of the lamp. The machine is completely automatic and means are pro-

vided for heating the glass and annealing it at the proper times.

The patent contains three claims and 11 references were cited by the Patent Office.

Sealing-in Machine. Patent No. 2,531,008. Filed Apr. 14, 1944. Issued Nov. 21, 1950. One sheet of drawings, none reproduced. Assigned to General Electric Company by Raymond H. Stuart.

This machine is for sealing the mounts in the ends of fluorescent lamps. It may be of the type shown in Patent No. 2,434,664 to F. J. Malloy. The machine is of the turret type having 16 heads which advance intermittently to a series of working stations where operations are carried out more or less in the usual manner.

The particular object of the invention is to avoid the formation of moisture discoloration bands on the inner wall of the envelope. This is accomplished by directing a stream of dry air into the tube while the gas-fired heating means are operating. This prevents the condensation of water vapor and so avoids the discoloration.

The patent contains three claims on the method and the machine and ten references were cited by the Patent Office.

Flattened Glass Tubing. Fig 6. Patent No. 2,529,678. Filed Aug. 4, 1949. Issued Nov. 14, 1950. Three sheets of drawings. Leonard C. Casselle, Thames, England, inventor.

This machine takes a round glass tube and flattens it by passing it between rollers while a flat bar is inserted in the tube. The figure shows the rollers 3 forming the leading edge of the flattened tube which has been heated to the softening point. The tube is then turned as indicated at A and B and passed through the rollers again to form the other edge against the flat bar.

The patent contains 4 claims and the references cited were 2,172,899, Barnard, Sept. 12, 1939 and 2,392,104, Smith, Jan. 1, 1946.

Glass Cutter. Patent No. 2,529,735. Filed March 15, 1947. Issued Nov. 14, 1950. One sheet of drawings not reproduced. Harry Martin, Cornbrook, Manchester, England, inventor.

This patent relates to wheeled cutters for cutting cold glass. The handle has a novel mounting for the cutting wheel.

The patent has one claim and the references cited were 557,200, Goodell, Mar. 21, 1896; 915,818, Baldwin, Mar. 23, 1909; and 1,419,310, Ryther, June 13, 1922.

Glass Beaded Wire. Patent No. 2,529,971. Filed July 31, 1946. Issued Nov. 14, 1950. Two sheets of drawings, none reproduced. Joseph Schmidinger, Lake George, N. Y., inventor.

This patent discloses a machine and method of making a wire having a series of glass beads secured to it at intervals. It is stated that such wires may be used for hot or pull wire switches. The machine feeds a vertical wire and at proper intervals a kink or offset is made in the wire. This offset is then moved into position in a forming die which contains granular glass. This is heated to form a bead on the wire. More than one wire may be used if desired. The wire is then advanced and the operation repeated.

The patent contains 15 claims and the references cited were 359,631, Prentice, Mar. 22, 1887; 2,030,185, Rose, Jr., Feb. 11, 1936; 2,220,742, Thorson, Nov. 5, 1940; 2,347,421, Little, Apr. 25, 1944; 2,348,035, Synek, May 2, 1944; 558,734, France, Sept. 1, 1923; and 624,239, France, July 11, 1927.

Stem Making Machine. Patent No. 2,530,168. Filed Sept. 24, 1946. Issued Nov. 14, 1950. Two sheets of drawings, none reproduced. Assigned to Westinghouse Electric Corporation by William J. Knochel and Charles Wiener.

This patent aims to prevent the over-oxidation of stem leads during manufacture, particularly when using "Kovar" leads. In this machine the conventional steps are employed except that the pressing time, which occurs after the machine indexes at the final heating and pressing operation point, is reduced to a degree that over-oxidation of the lead wire cannot take place. In accordance with the normal procedure, a long heat soaking is employed after the pressing jaws operate. This machine has a second pressing operation to occur a few seconds before the machine indexes to the next position.

The machine is of the turret type advanced step by step by a Geneva movement. The patent contains seven claims and the references cited were 872,530, Meeker, Dec. 3, 1907; 1,338,500, Eisler, Apr. 27, 1920; 1,579,765, Higgins, Apr. 6, 1926; 1,640,442, DeJong, Aug. 30, 1927; 1,655,140, Fagan, Jan. 3, 1928; 1,655,141, Fagan et al., Jan. 3, 1928; and 1,741,016, Eisler, Dec. 24, 1929.

Forming Glass Tubing. Fig. 7. Patent No. 2,531,394. Filed June 2, 1945. Issued Nov. 28, 1950. One sheet of drawings. Assigned to Farnsworth Research Corporation by Clair E. Campbell.

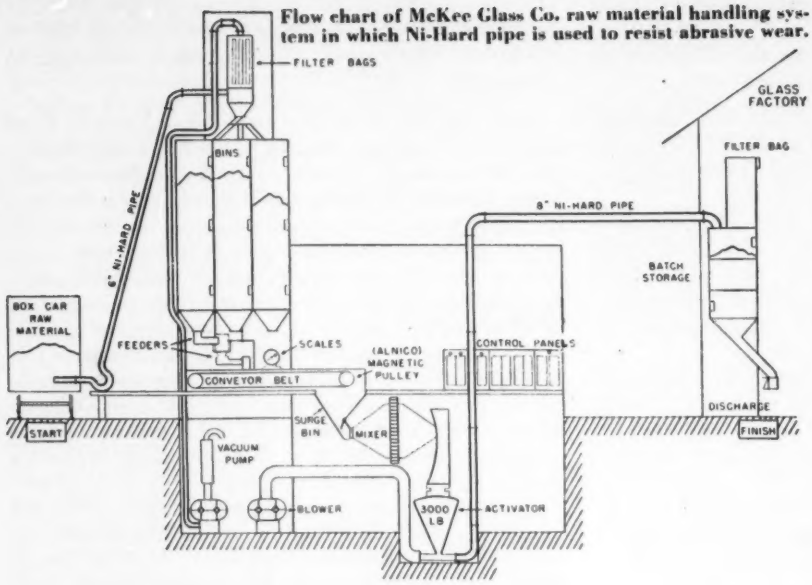
This machine is for reforming glass tubing so as to secure exact inside diameters. The figure shows a cylindrical forming mandrel 20, the diameter of which is that desired for the inside of the finished tube. The mandrel has a bore 23 with radial ports running to the outer surface. A glass blank 21, having one end closed, is placed over the mandrel. The other end of the blank is connected by a smaller tube 25 to a source of vacuum. A ring 26 surrounds the tube and is heated by an induction coil 27. As the ring is moved to the right in the figure, the glass is softened and collapsed against the mandrel which is later removed. This provides an exact inside diameter in the tube.

The patent contains three claims and the references cited were 1,301,714, Kueppers, Apr. 22, 1919; 1,963,008, Weeks, June 12, 1934; 2,084,811, Keen, June 22, 1937; 2,209,739, Meyer, July 30, 1940; and 2,286,401, Everett, June 16, 1942.

Electron Discharge Tube. Patent No. 2,533,589. Filed Jan. 14, 1946. Issued Dec. 12, 1950. One sheet of drawings, none reproduced. This invention by Messrs. Kronouer, Lips, and Prakke, all residents of Eindhoven, Netherlands, was assigned to Hartford National Bank & Trust Company, Hartford, Conn. An application was filed in Netherlands Aug. 13, 1943 and the U. S. patent expires Aug. 13, 1963.

The invention consists of a treatment of lead-in conductors to be sealed into a glass envelope particularly useful in short wave apparatus. A chrome-iron wire is electroplated with a coating of copper, silver, or the like to a thickness of from 5 to 10 microns. Then a layer of chromium is electrically deposited to a thickness of not over

(*Continued on page* 40)



Flow chart of McKee Glass Co. raw material handling system in which Ni-Hard pipe is used to resist abrasive wear.

SPECIAL ALLOY PIPE SOLVES PROBLEM OF ABRASION IN BATCH SYSTEM

The McKee Glass Company of Jeannette, Pennsylvania, has had the unique experience of being the first glass plant to unload its raw materials and to deliver its mixed batch entirely by air.

The batch plant and batch conveyor system were designed by the Convair Corporation of Pittsburgh, Pennsylvania, and built in 1947.

There are three vacuum systems for unloading raw materials: namely, one six-inch system for unloading sand, borax, boric acid, and cryolite; one five-inch system for unloading sand, syenite, fluorspar, lime, and soda ash; and a second five-inch system for conveying crushed cullet to the over-head storage bins. These systems were originally equipped with standard steel pipe which wore through within a year of operation. The high velocity of the raw materials (approximately 100 miles per hour) and the hardness of some of them proved to be too severe an abrasion factor for this type of pipe. Iron contamination and maintenance became quite a problem so a search was begun for other materials to resist this severe service.

Rubber lined pipe of several manufacturers were tried. The iron "pickup" was eliminated as long as the ¼" rubber lining was intact, but the abrasion was too great for this type of lining and the pipe had to be replaced when less than 2,000 tons of abrasive material was conveyed.

With the failure of rubber line pipe to do a satisfactory job, several test plates of high hardness metals were placed in the systems to test their resistance to abrasion. Of the various plates tested, "Ni-Hard", a special nickel chromium white cast iron of the International Nickel Company, showed the most resistance. Upon this test, all of the three vacuum systems were ordered in "Ni-Hard" cast pipe. The pipe sections are about 10 feet long (which is the limit of casting) and have no flanges. The pipe must be joined by Dresser Couplings which slip over the pipe ends. The bends are also cast of Ni-Hard from a special pattern so that 3-30 degree bends are required to make a 90 degree turn. This construction cuts the cost of replacing worn sections.

The Convair system that uses pressure to convey batch has not been nearly as severe on pipe as the vacuum systems. The material speed is only about 60 miles per hour which is considerably less than the vacuum systems. However, to eliminate any excess "iron pickup" in delivery of the mixed batch, the 8" steel pipe has been replaced by 7½" I.D. cast Ni-Hard pipe.

Since the installation of "Ni-Hard" pipe in both the Vacuum systems and the Convair system has been completed, the iron "pickup" has been reduced at least 80 per cent and maintenance on the lines is very small.

FELDSPAR DISCOVERY IN CANADA

Analysis of Saskatchewan's first major occurrence of feldspar has shown the mineral to be "a number one grade feldspar of very good quality for use in the manufacture of ceramic ware or glass", according to a report of provincial authorities in Regina.

Samples of the feldspar, discovered early this summer by Dr. J. B. Mawdsley of the University of Saskatchewan in the course of investigation in the Nunn Lake area 40 miles east of Lac la Ronge, were sent to the University of Saskatchewan and the Canadian Government's Department of Mines and Technical Surveys. Analysis in each case showed the feldspar to contain 65.15% silica, 19.55% alumina, .04% ferric oxide, and a potash to soda ratio of 3.23 to 1.

A spokesman for the provincial authorities said the low iron content and high alumina to silica ratio are advantageous in the manufacture of glass and the high potash to soda ratio qualifies the feldspar for use in ceramic ware manufacture.

Dr. Mawdsley's discovery of feldspar is a flat-lying dike about four feet thick, with about 5,000 tons exposed at the outcrop, by rough estimate. The flat nature of the outcrop would make for easy quarrying. However, a spokesman said, the find was the same type of spar produced in quantity in southwestern South Dakota and markets for the Saskatchewan spar would necessarily be local and possibly slow to develop. He added that the glass and ceramic industries at Redcliff and Medicine Hat, Alberta, might eventually provide a market for a worthwhile tonnage of this mineral.

• The Board of Directors of Thatcher Glass Manufacturing Company has declared a dividend of $.60 per share on its Convertible Preference Stock, payable February 15 to stockholders of record January 31. This is Dividend No. 139.

Research Digest

Autoclave Test of Glass Containers With Acid Test Liquid

In applying the autoclave test at 121°C. for 1 hour to bottles, capped with tin foil, containing a sulphuric acid as proposed by Sub-Committee VII-A, Committee C-14 (Glass and Glass Products) A.S.T.M. and U.S. Pharmacopoeia Glass Containers Advisory Committee, it was found that, with containers of highly resistant glass, the concentration of acid after test was greater than before. The cause has been investigated by J. F. Greene and A. L. Hinson and reported in the *Bulletin of the National Formulary Committee*, 1949, 17 (3/4), 48-56.

It was deduced theoretically that when pressure was released to allow cooling from 121° to 100°, 4% of the test liquid (mainly water) would need to be vaporized, and experiments made with containers of various sizes filled and weighed, autoclaved, cooled, and re-weighed, show that the losses ranged from 1.5 to 4.0%, small bottles giving the low values, and actual loss varying with size and shape of container.

The error introduced in titration values for the alkali extracted from the containers was then deduced as (1) proportional to the fraction of water lost, (2) proportional to the concentration of acid after test, and (3) greatest when test acid was not neutralized, *i.e.*, for resistant glasses. This showed the futility of running a "blank" for the water loss.

Rate of cooling of the autoclave was an important factor, and a rate of 0.5°/minute was finally recommended. In order to measure acid lost by volatilization, 0.0005 N-H_2SO_4 was charged into fused silica bottles of 1, 2, 4, 8, 16, and 32 oz. capacity. The bottles and contents were weighed before and after autoclaving for 1 hour at 121°, and the acid titrated against 0.02N-NaOH. It appeared that about 1.0% of the acid was lost on cooling from 121° to 100°.

In order to correct for this error in autoclaving with acid solutions at 121° the following procedure was suggested:

(1) Use acid as dilute as possible, namely, 0.0005 or 0.0002N-H_2SO_4.
(2) Cool the autoclave at 0.5°/minute.
(3) Correct the final titration (T_2') for water and acid loss by the formula $T_2' = T_1(1.01 - f)$

where T_1 = initial titration, T_2' = corrected final titration, f = fraction of water lost and $f = W_1 - W_2/V_1$, where W_1 = wt. of filled bottle before, and W_2 = wt. after autoclaving.

V_1 = volume of test acid filled.

In the case of round pharmaceutical containers of over 15 c.c. capacity, $T_2' = 0.98\ T_2$.

Glass Durability Tests—Effect of Shape and Size of Containers for Injections

In the autoclave procedures proposed for inclusion in the National Formulary IX and U.S.P. XIV for testing containers for injections, the results for the alkali extracted from the bottles varied when the size of bottle was changed. It might be useful, therefore, knowing the result for one size of bottle, to be able to decide the approximate value which would be obtained on another size, if the glass were the same. J. F. Greene and A. J. Hinson have considered the geometry involved in the case of round containers, as generally used by the pharmaceutical trade in the United States, and have reported the results of this investigation in the *Bulletin of the National Formulary Committee*, 1949, 17 (3/4), 61.

They showed that, if A = total area of glass attacked, V = volume of contents, or of container, K = rate of attack per unit area, for a given form of attack, and a given type of surface, and N = titration value in autoclave test specified

then

$$N = \frac{A}{V} K \qquad (1)$$

Assuming containers of a homologous series (round)

$$\frac{A}{V} = \frac{mD^2}{D^3} = \frac{m}{D} = \frac{m}{n\sqrt[3]{V}}, \text{ where } m \text{ and } n \text{ are constants} \qquad (2)$$

For round bottles of different shapes, *i.e.*, for which the main variable is the ratio of height to diameter (y)

$$\frac{A}{V} = \frac{3.69(\frac{1}{2} + y)}{y^{2/3}\sqrt[3]{V}} \qquad (3)$$

In containers used in the U.S.A. for injections, y varied from 1.2 to 2.6. Substituting in (3), the difference in $\frac{A}{V}$ for two bottles of volume V, but of limiting shapes for the containers under consideration, is 8.5%. Therefore all round containers for pharmaceuticals in the U.S.A., might be regarded as homologous shapes, and combining (1) and (2).

$$N = \frac{m}{n\sqrt[3]{V}} K,$$

indicating that, for a given test method, the concentration of alkali extracted is inversely proportional to the cube root of the volume.

Further, for two bottles of different sizes, V_1 and V_2.

$$\frac{N_1}{N_2} = \frac{\sqrt[3]{V_2}}{\sqrt[3]{V_1}}, \therefore \log N_1 - \log N_2 = -\tfrac{1}{3}(\log V_1 - \log V_2)$$

Hence, if values for N are plotted on log-log paper, against volume V, the graph should be a straight line with a slope of $-\frac{1}{3}$.

This relation was affected to some extent by variations in actual shape, and by the changes in N due to changes in attacking solution in different shapes, so that commercial bottles, even of the same composition and apparent surface conditions, could exhibit variations. Previous history would affect the rate of extraction.

Results for five different types of glass, tested according to the proposed standard procedures (water at 121° and dilute H_2SO_4 at 121°, for 1 hour, plotted on log-log paper against "bottle fill" gave, in general, straight lines more or less parallel to a line of slope $-\frac{1}{3}$. Thus, knowing a test result for one size of bottle, values for other sizes could be read from a straight line with a slope of $-\frac{1}{3}$, drawn through this point.

(*Continued on page 46*)

Science Replaces Empiricism

In recent years the glass industry has made great strides in applying sound scientific principles to all phases of glassmaking—all the way from batch mixing through the lehr to the packing room. And this progress is to be found nowhere more outstanding than in batch formulation . . . specifically in amber glass.

Therefore, when Calumite was offered as the ideal batch constituent for amber glass, it won immediate acceptance.

Its performance in producing quality amber ware has exceeded expectations because with Calumite Company's skilled batch engineering service, it is producing amber ware that works well on machines, is stable and free from seeds and blisters; it produces amber with good reddish tints, and color intensity is maintained from day to day . . . in short, it provides

"A Scientific Approach to Amber Glass Manufacture"

The Calumite Co.
HAMILTON, OHIO

1951 MARKS FIFTIETH ANNIVERSARY OF NATIONAL BUREAU OF STANDARDS

As recognition of the role that the National Bureau of Standards plays in science, a large number of the principal scientific and technical organizations of the nation have planned meetings in Washington during 1951 to honor the Bureau's Semi-centennial. In addition, a number of committee conferences and meetings of local sections of societies will be held at the Bureau and the Bureau is planning a series of symposia on special topics to be held during the year.

Created by Act of Congress on March 3, 1901, the National Bureau of Standards is the principal agency of the Federal Government for fundamental research in physics, mathematics, chemistry, and engineering. The Bureau's activities are thus largely concerned with the physical sciences, although the close inter-relationships of the major fields of science preclude the drawing of sharp lines of distinction.

The history of the Bureau actually extends back to the Constitution, which gave cognizance of weights and measures to the Federal Government. An Office of Weights and Measures grew out of various acts of Congress beginning in 1830, and this Office was the immediate antecedent of the Bureau.

At the close of the last century, American industry and science recognized the need for a major, national physical laboratory similar to those established in England and Germany. Today, all working standards in research laboratories and industry are calibrated in terms of the national standards of physical measurement which the Bureau maintains. In addition, the Bureau carries on necessary research leading to improvements in such standards and in related measurement methods and instruments. New standards, methods, and instruments, in keeping with demands for greater precision and the opening up of new fields of science and industry, are also objects of research.

SURFACE COMBUSTION NAMES SALES ENGINEER

Charles E. Newman has been named sales engineer for the Chicago territory of Surface Combustion Corporation and, as such, will handle all lines of the company's standard industrial equipment, according to a recent announcement.

Mr. Newman received his engineering training at the University of Toledo and joined Surface Combustion in 1936. Since 1943, he has devoted his time to sales-service activities in the office of A. H. Koch, head of the standard industrial equipment line.

O. HOMMEL SERVICE AWARDS

Twenty-three employees of the O. Hommel Company were given service awards by its President, Ernest M. Hommel, at a company presentation held in December. Service records of recipients ranged from 5 to 35 years. The awarding of service pins has been a company custom since 1938.

In an address to all employees of the company's Carnegie plant, Mr. Hommel pointed out that the firm has 60 years of experience to draw on for guidance during the uncertain months that lie ahead for all business.

CURRENT STATISTICAL POSITION OF GLASS

Employment and payrolls: Employment in the glass industry during October 1950 was 128,300. Compared with the previous month's adjusted figure of 118,100, October employment jumped about 7½ per cent over September. During October 1949, employment had been 107,400, which is close to 19½ per cent below October 1950.

Payrolls during October jumped considerably to reach a preliminary $36,315,743. This is about 16½ per cent above September payrolls of an adjusted $31,176,826. During October 1949, payrolls were $26,136,864.

Glass container production during November 1950, based on figures released by the Bureau of Census, dropped off and was reported to be 9,441,331 gross. Compared with the October production of 10,611,617 gross, November production dropped about 11 per cent. Production during November 1949 was 7,374,851 gross, or 28 per cent below November 1950. Thus far during 1950, glass container production has reached a total of 97,132,767 gross. This represents close to 16 per cent more than for the same period in 1949 when production had reached 83,791,712 gross.

Shipments of glass containers for November 1950 were 8,325,876 gross. This indicates a decrease of about 9½ per cent as compared with the shipments of 9,212,080 reported for October. Shipments during November 1949 were 7,196,984 gross, which is about 15½ per cent below November 1950. Glass container shipments at the close of the eleven months January-November 1950 have reached 98,431,081 gross. This is about 18 per cent ahead of the corresponding period in 1949 when shipments had reached 83,144,002 gross.

Stocks on hand at the close of November 1950 continued to be of better supply and were reported to be 7,063,678 gross. At the close of October 1950, stocks were 6,123,066 gross and at the close of November 1949, they were 8,680,951 gross.

Automatic tumbler production for November 1950 dropped off 16 per cent to reach 5,876,177 dozens. This is in comparison with the 6,994,350 dozens produced during October. During November 1949, production was 4,939,817 dozens. Shipments, however, increased 11 per cent over October's 5,498,188 dozens to reach 6,106,785 dozens. Shipments during November 1949 were 4,961,121 dozens. Stocks on hand at the close of November 1950 were 9,592,759 dozens. This is 8 per cent more than at the close of October 1950 when stocks were 8,876,870 dozens. Stocks on hand at the close of November 1949 were 7,614,621 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware dropped close to 14 per cent during November 1950 to reach 3,312,712 dozens. During October 1950 sales were 3,846,035 dozens and during November 1949 they were 3,647,448 dozens. Total manufacturers' sales at the close of the 12-month period ending November 1950 have reached 38,830,885 dozens. This is about 1½ per cent below the manufacturers' sales of 39,426,468 reported for the corresponding period in 1949.

GLASS CONTAINER SHIPMENTS

(All figures in Gross)

Narrow Neck Containers	November 1950
Foods	669,031
Medicinal & Health Supplies	1,323,716
Chemicals, Household & Industrial	571,003
Beverages, Returnable	311,790
Beverages, Non-returnable	12,727
Beer, Returnable	219,686
Beer, Non-returnable	239,647
Liquors	913,828
Wines	343,062
Toiletries & Cosmetics	524,802
Sub-total (Narrow)	5,129,292
Wide Mouth Containers	
Foods	2,056,652
Dairy Products	326,665
Home Canning	*
Medicinal & Health Supplies	280,730
Chemicals, Household & Industrial	115,785
Toiletries & Cosmetics	104,394
Packers' Tumblers	88,772
Sub-total (Wide)	2,972,998
Total Domestic	8,102,290
Export Shipments	223,586
Total Shipments	8,325,876

*This figure is included with Wide Mouth, Foods.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All figures in Gross)

		Production November 1950	Stocks November 1950
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,489,819	2,494,823
	Wide Mouth	3,084,341	2,278,445
Dairy Products		360,733	257,708
Home Canning		*	*
Beverages, Returnable		392,503	556,828
Beverages, Non-returnable		11,445	21,458
Beer, Returnable		290,245	204,430
Beer, Non-returnable		245,530	214,116
Liquors		1,029,735	633,501
Wines		420,741	294,047
Packers' Tumblers		116,239	108,322
Total		9,441,331	7,063,678

*This figure is included with Wide Mouth, Foods.

AIR REDUCTION TO BUILD NEW PLANT

The purchase of a site at Butler, Pa., for the erection of a new plant for the manufacture of oxygen and nitrogen, together with related facilities, has been announced by H. R. Salisbury, President of Air Reduction Sales Company.

The new plant, capable of producing very large quantities of oxygen per day, both liquid and gaseous, will also produce liquid and gaseous nitrogen and other gases extracted from the air.

FOREIGN GLASS SANDS

Glass sands have been found on an extensive scale below the lignite at Meting in Sind, according to a recent report in *Mineral Trade Notes,* Oct. 1950, U. S. Dept. of Interior, Bureau of Mines. If these prove to be of good quality, as is indicated by results obtained in the Indus Glass Works, Hyderbad, the problem of raw material for glassmaking in Sind should be solved. Geological survey parties working in the Hazra district recently reported very pure looking sand from this district. Sand that might be suitable for glassmaking also is under examination in East Bengal.

According to a press notice in January 1949, at a conference held at Karachi under the chairmanship of Abbas Khaleeli, the Director-General of Exports and Imports, it was decided to form an association for the exploitation of silica sand in Sind. It was said that the association would have a working committee of seven, including a representative of the Sind Government, a representative of the Geological Survey of Pakistan, and a representative of the Development Wing of the Industries Department. Glass sand is found at Jungshahi and Mukhan Mol in Sind and in the trans-Indus salt range in Miawali and Paniala in West Punjab and NWFP districts, respectively.

The Director of the Geological Survey, Dr. Crookshank, informed the conference that there was 320,000 tons of sand that could be exploited for the glass industry and for the manufacture of sodium silicate and, with normal exploitation, this quantity would last 20 years.

At present, Sind is charging a royalty of 4 annas per cubic foot. The question of royalty payable to the Sind Government also was discussed. At present ten glass and sodium silicate firms are operating in Karachi.

Later in the year a bulletin entitled "Glass Industries in Pakistan" was published by the Department of Supply and Development, Ministry of Industries. In the report, "Pakistan Industry", there is a statistical summary of the position of the glass industry as of September 1949. A number of reports on the subject of glass sands were issued in 1949, all stating the keen interest in the silica sand at Jungshahi. Although the deposits are fairly large, the present output is limited to about 800 tons per year.

BROWN INSTRUMENTS EXPANSION

Minneapolis-Honeywell Regulator Company is expanding its industrial production and operating facilities in Philadelphia, according to Henry F. Dever, President of the company's Brown Instruments Division.

The new expansion is made possible, according to Mr. Dever's announcement, by the purchase of the Thomas M. Royal plant. The company has also acquired about 60,000 square feet of undeveloped property in addition and adjacent to its new site. This Honeywell-Brown expansion is the second in less than two years and Brown Instruments Division employment is nearing the 2000 mark.

• Wyandotte Chemicals Corporation, Michigan Alkali Division, has moved its Cincinnati office to 825 Dixie Terminal Building, Cincinnati 2, Ohio.

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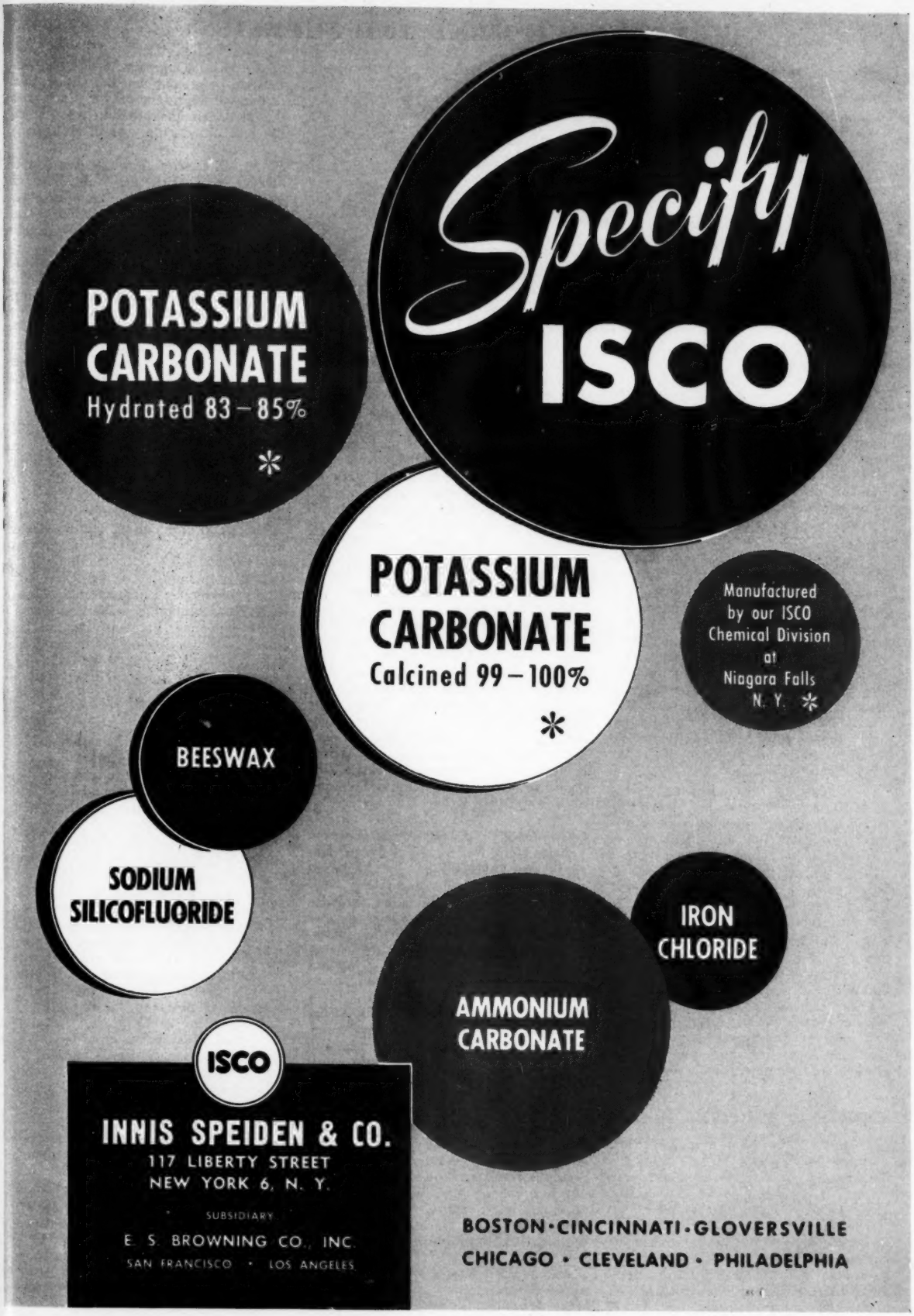
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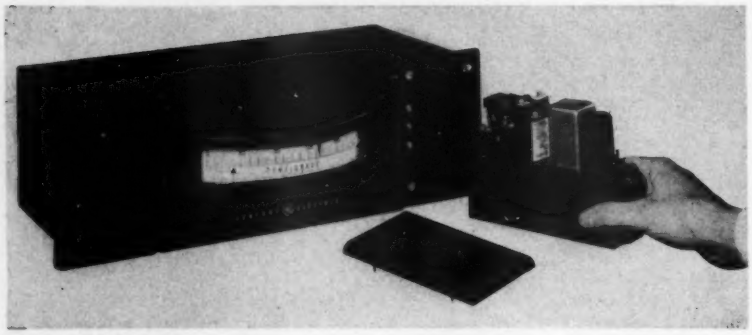
NEW EQUIPMENT AND SUPPLIES



NEW G-E PYROMETER EQUIPMENT

General Electric Company, Schenectady, New York, has announced the production of new pyrometer equipment which offers accurate temperature indication, close temperature control of industrial processes and protection for furnaces, ovens, and kilns. The complete line consists of flush- or surface-mounted indicators, controllers, and protectors.

Designed for industrial applications that include heat treating furnaces, brick, cement, or ceramic kilns; melting furnaces, etc., the instrument has a calibrated accuracy within ¾ of 1 per cent of full scale. A legible 7-inch scale, fitted with an anti-glare cover, indicates any change in temperature equivalent to 1/10 of 1 per cent of full scale. Immediate control action follows. Normal changes in humidity, ambient temperature, and voltage have little or no effect on the exactness of the control action.

The heart of the indicating instrument is a 3¼-pound magnet, which provides higher flux density and allows larger air gaps than are found in conventional instruments. Foreign matter will not impair the operation of the instrument since the indicator is so sealed that it can be installed in humid or dirty locations.

The indicating device is a millivoltmeter that is connected to a thermocouple on the furnace or other heating equipment. The difference between the hot and cold junctions of the thermocouple causes small voltages. These voltages, being proportional to the temperature, are indicated on a scale marked in Fahrenheit or Centigrade.

CATALOGS RECEIVED

St. Joseph Lead Company, 250 Park Avenue, New York 17, New York, is distributing, by request on a company letterhead, its new booklet, "Technical Data for the Consumer".

The fifty-five page book is intended to be a complete and informative manual on lead-free zinc oxide and includes only that material which is of maximum interest and value to technologists in the consuming industries.

The book is divided into two parts. Section I concerns itself with the production of St. Joe commercially lead-free zinc oxides. It is a detailed and illustrated, step-by-step itinerary which begins underground in a St. Joe zinc mine and ends with the packaging of the finished product. Section II contains representative technical data on St. Joe's various grades of black, red, and green label zinc oxides, accompanied by photomicrographs and charts analyzing their particle size distribution characteristics. In addition, Section II includes a brief discussion of the role of zinc oxide in the major consuming industries.

Chapter headings include A Short History of the St. Joseph Lead Company; The Production of St. Joe Zinc Oxides; General Properties of Zinc Oxide; Zinc Oxide in Rubber Compounds; St. Joe Rubber Grade Zinc Oxides; Zinc Oxide in Protective Coatings; St. Joe Paint Grade Zinc Oxides; Zinc Oxide in the Chemical, Pharmaceutical, and Other Industries; Zinc Oxide in the Ceramic Industries; and St. Joe Ceramic Grade Zinc Oxides.

Owens-Corning Fiberglas Corporation, Toledo, Ohio, has issued a design data sheet describing "Fiberglas Textured and Perforated Acoustical Tile".

The eight-page publication includes data on the textured and perforated acoustical products, application methods by adhesive, mechanical suspension or clipping on wood furring strips and specifications.

Hagan Corporation, Hagan Building, Pittsburgh 30, Pa., describes and illustrates with diagrams twelve suggested applications of the Hagan ratio totalizer in a new bulletin which has just been made available.

Applications in computing circuits discussed include addition, subtraction, multiplication and division, averaging, and reversal of loading pressure. For regulation and control action, the ratio totalizer can be used to obtain a proportional band action, with automatic reset if required, a rate action, or a combination of proportional band plus automatic reset plus rate action.

A cutaway drawing in color illustrates the principles of operation and other drawings illustrate modifications of the basic design for special use. The bulletin points out that the applications illustrated represent only a fraction of the arrangements possible when using the unit either singly or in multiple.

Foster D. Snell, Inc., 29 West 15th Street, New York 11, New York, is distributing a brochure answering the question: What is the function of the chemical consultant in today's industrial research?

Aside from illustrations of facilities and equipment, the 20-page booklet outlines briefly the relation of equipment and personnel of the consultant, the results to be expected on various types of problems. This is followed by a discussion of "why use a consultant", "what is research?", and "what can research buy?".

Barber-Greene Company, Aurora, Illinois, has announced the publication of Bulletin 362 which describes its lightweight Model 362 portable belt conveyor.

The eight-page bulletin lists dozens of users and applications and illustrates with sketches applications of stockpiling, reclaiming, car unloading, truck loading, stockpiling, filling bins, handling wet concrete, bagged or packaged materials. Included are numerous photographs of machine design features, as well as scenes of the conveyor in various field applications. There is also a page devoted to other Barber-Greene conveying and car unloading equipment.

Chicago Wheel & Mfg. Company, 1101 West Monroe Street, Chicago 7, Illinois, has issued a four-page folder featuring its new vitrified bond for grinding wheels and mounted wheels, "79E".

The folder outlines the advantages and applications of the abrasive development, claiming a 5 to 10% increase in grinding and finishing output.

The Burrell Corporation, Pittsburgh, Pa., has announced an all new catalog which is a reference work on all kinds of laboratory apparatus and supplies. It lists over 25,000 items and includes many improved methods and aids for chemical analysis and testing.

Referred to as Catalogue No. 450. the booklet features a cross-index system. Items are listed by name and again, separately, by function. A complete description of each item accompanies every listing.

Carboline Company, 7603 Forsyth Blvd., St. Louis 5, Missouri, is distributing Data Sheet C-42 which describes the process of applying Carbo-Kote 6020, a thick protective coating for tank and duct linings and for protection of equipment and floors.

Coverage, drying, and working times, corrosion resistance, uses and prices are given in the folder, as well as general information on the product.

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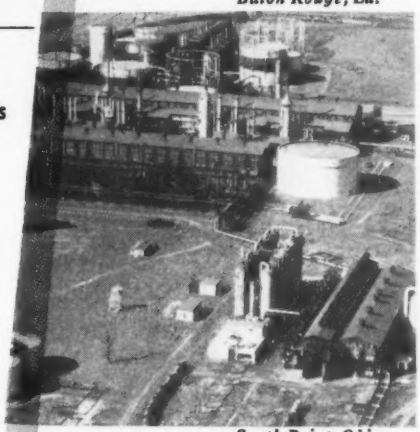

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INVENTIONS AND INVENTORS . . .

(*Continued from page* 31)

1 micron. When the wire is sealed into the glass this layer is converted into chromic anhydride. This makes a much better seal than has been possible with prior methods.

The patent contains three claims and the references cited by the Patent Office were 1,576,436, Gustin, Mar. 9, 1926; 1,615,585, Humphries, Jan. 25, 1927; 1,651,278, Humphries, Nov. 29, 1927; 1,746,987, Bennett, Feb. 11, 1930; 2,217,422, Scott, Oct. 8, 1940; 2,420,291, Adler, May 13, 1947; 23,404, Great Britain, 1910; and 379,883, Great Britain, Sept. 8, 1932.

Tube Sealing Machine. Patent No. 2,532,860. Filed Dec. 22, 1948. Issued Dec. 5, 1950. Three sheets of drawings, none reproduced here. Assigned to Hartford National Bank and Trust Company by W. A. Roovers, C. F. Veenemans and O. L. Van Steenis all of Eindhoven, Netherlands.

This machine seals off the exhaust tube of electric discharge tubes. The patent contains three claims, the first of these summarizing the invention as follows: An apparatus for sealing off an electric discharge tube having an envelope including contact pins and an exhaust tube which extend from the said envelope in substantially parallel relation, comprising a metal tube holder having spaced elongated recesses adapted for receiving said contact pins and a passageway adapted for receiving said exhaust tube and also having radial slots extending from the periphery of said holder inwardly to said passageway, said slots being positioned between said recesses and above the lower ends thereof and having a width less than the said spacing between the said recesses, and a partition in said slots forming separate passages therein and adapted to receive heating flames selectively from burners in alignment with said slots at the outer periphery of said tube holder.

The references cited by the Patent Office were 2,215,100, Gustin, Sept. 17, 1940; 2,273,445, McGowan et al., Feb. 17, 1942, 2,278,500, Smith, Apr. 7, 1942; and 2,434,664, Malloy, Jan. 20, 1948.

AMERICAN POTASH UNION AGREEMENT AT TRONA PLANT

The American Potash & Chemical Corporation has announced confirmation of a union contract agreement at its plant at Trona, California.

The agreement between the company and Local 414 of the International Union of Mine, Mill and Smelter Workers calls for hourly wage increases ranging from 12 to 18 cents, and became effective December 1, 1950.

PENNSYLVANIA CERAMICS ASSOCIATION ELECTS OFFICERS

The Pennsylvania Ceramics Association has announced the election of the following officers for 1951: James K. Martin, President; H. A. Heiligman, Vice-President; E. C. Emanuel, Treasurer; R. G. Ehman, Secretary; and E. C. Henry, Managing Director.

The next scheduled meeting of the Association will be the annual "Penn State Night" program, a joint assembly of the Association and the Philadelphia Section of the American Ceramic Society, to be held March 29, 1951.

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NEW KNOX FACILITIES . . .

(*Continued from page* 21)

including the examination of ring sections for homogeneity. A Beckman spectrophotometer capable of making transmittance measurements from the ultraviolet region through the visible and into the infrared is shown in operation. This instrument becomes important in the control of glass color in various phases of the industry requiring different colored glasses. It is necessary in many stages of the operation of a glass factory to obtain industrial standards for comparison which can be set up for the unification of the entire industry in the production of colored glasses. Such programs utilize the facilities of various laboratories, both in the glass container industry and in private laboratories, to obtain reliable data for the use of the entire industry.

Several times in very recent years it has become necessary for the glass industry to do exactly this job and it is a credit both to the technical personnel and to the management of the various companies that such programs could be executed with skill and dispatch.

Figure 5 shows where a part of the physical testing is done as a duplication and check on the plant determinations as a means of independent check control for the general improvement of operation. Figure 6 shows a single-head Preston hydrostatic pressure testing machine with the special lightweight spindle in place for use in covering the maximum range of pressure testing which is required by a large variety of ware made by the Knox companies. Figure 7 shows one of the highly trained technicians utilizing a petrographic microscope for the examination of stones which may appear from time to time in glass, or impurities which may be present in batch materials coming through various plants. This phase of technical control is one which has been long discussed, but all too little used for the betterment of the industry. The setup illustrated is one which provides the maximum of flexibility and the least advance preparation for routine examination of transparent mineral type objects. A more complete and painstaking preparation is necessary upon many occasions in order to provide such

Fig. 7. Petrographic microscope being used by technician Hilda Needle.

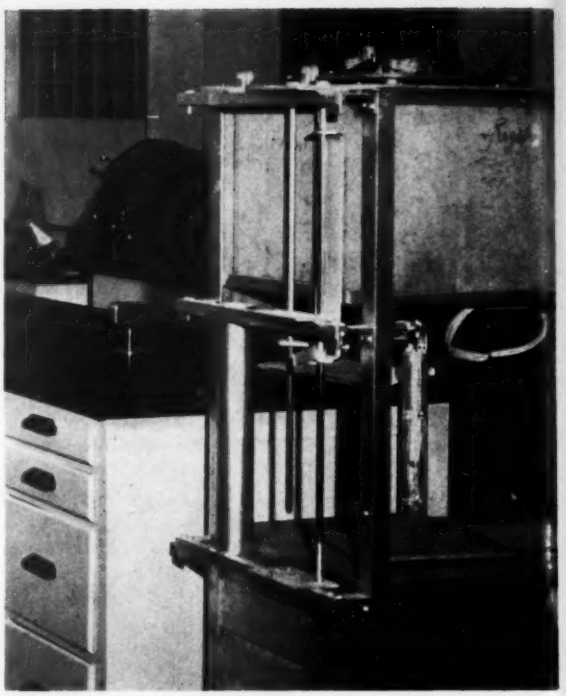

Fig. 8. High temperature electric furnace with a maximum temperature of 3000°F.

information to be of substantial service in laboratory or production control. Such auxiliary equipment as grinding and polishing benches are often called into play to prepare paper-thin cross-sections for examination under high magnification.

A very well-equipped glass blowing department is available to the laboratory personnel for the provision of highly complex special glassware sometimes needed in analytical and research laboratories. This makes it possible to apply with ease the most recent and the most complicated of analytical procedures and provides a flexibility which is normally encountered only in the most highly endowed research centers and universities throughout the land.

Since most research work is of such nature that it is not normally disclosed in any detail until completed, it is possible only to give you a glimpse of parts of the equipment which is being used in the research work here in Knox. Figure 8 shows a furnace which is capable of producing a temperature of 3000° Fahrenheit and is being used for a part of this work. Equipment such as this is built in the Knox laboratory shop in order that it may be carefully constructed and modified as necessary to provide the ever changing facilities which have become a part of any modern research laboratory.

An up-to-date library is maintained at Knox for the benefit of the technical personnel who are required to carry out this work and, as has been shown many times in many industries, it has proven itself to be a much worthwhile tool for the every day technician, and not just a vast array of books to impress visitors.

As time and the course of industry go on we all know that it will be necessary to make changes, and provision has been made for the expansion and improvement of

(*Continued on page* 44)

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NEW KNOX FACILITIES . . .

(*Continued from page* 42)

facilities as a continuation of the program which we see already developed to a high state. Already it has been necessary to take over additional space in order to provide the necessary help to the various plants in the Knox Group in order to ease material shortages which are again arising and additional facilities beyond these have been planned for the near future to make it possible to provide even more help to management and consumer alike in the problems which arise from day to day.

CORNING TO CELEBRATE HUNDREDTH YEAR

Amory Houghton, Chairman of the Board of Corning Glass Works, has announced that the company will commemorate its hundredth anniversary in 1951.

The firm was founded in Somerville, Mass., in 1851 as the Union Glass Company by Amory Houghton, great-grandfather of the present Chairman. It then moved to Brooklyn in 1864 and, four years later, was transferred to Corning by canal boat.

Today, not including its subsidiaries and affiliated companies, Corning Glass Works employs over 8,000 residents in the Corning area and over 4,000 in other cities, including Central Falls, R. I., Wellsboro, Pa., Bradford, Pa., Charleroi, Pa., Muskogee, Okla., Albion, Mich., Parkersburg, W. Va., and Leaside, Ontario.

CADMIUM DISTRIBUTION DISCUSSED

Temporary action to provide some cadmium immediately for certain highly essential non-defense uses, and plans for a longer-range program to stretch supplies of this commodity to meet both defense and other important requirements were discussed at a meeting of the Cadmium Industry Advisory Committee recently with officials of the National Production Authority.

Because rated defense orders for cadmium metal, oxides, and salts exceed the total available supply, NPA has sent individual directives to producers and prime distributors on filling of orders through next January 31. These temporary directives provide that "DO" orders, including those on hand, be filled up to 50 per cent of the amount of each order. However, where supplies do not permit filling orders to that extent, they are to be filled on a proportionate basis. The temporary directives were necessary, the industry committee was told, to prevent a complete shut-off of supplies for non-defense uses.

In discussing plans for a longer-range program covering cadmium distribution, both the industry committee and NPA agreed that an order should be developed which would (1) establish cadmium inventory controls and (2) set up a specific list of permitted cadmium usage. Such a list of permitted usage was in effect during World War II, it was pointed out.

The majority of the industry committee stated that allocations of cadmium are not needed at this time, but all expressed the view that controls on the permitted consumption would assist in distribution of available supplies to meet both defense and other highly essential requirements.

C. P. OVERMYER SPEAKS AT WEST COAST MEETING

C. P. Overmyer, President of the Overmyer Mould Company, was the speaker at the December meeting of the Glass Division of Southern California.

Mr. Overmyer discussed glassmaking practices in South American and European factories with particular reference to types of equipment and quality of product. He emphasized the remarkable progress that has been accomplished during the past few years in many of the South American glass factories and in particular the low ratio of glass factories to the total population. There is apparently an increasingly large market for containers in most of these countries and North American engineering and technical services are for the most part highly valued and in great demand. The progressive attitude of these countries toward lightweighting and improved container design is an indication of trends throughout the industry.

The subject of mold metals was discussed with particular reference to new metals and to improved foundry practices, as well as the application of new metals to specific problems. Mr. Overmyer's remarks were practical and stimulating and the discussion that followed the meeting bore evidence of this fact.

THREE NEW OFFICERS OF CAMBRIDGE WIRE CLOTH

The Cambridge Wire Cloth Company has announced the appointment of three new officers. They are Irwin F. Pink, Executive Vice President, Edward N. Evans, Vice President and General Manager, and Nina E. Pink, Secretary and Treasurer.

Mr. Pink joined the company in 1920. He was elected Secretary and Treasurer in 1938, Vice President and General Manager in 1942, and held the latter position until his recent appointment.

Mr. Evans has been with the firm following his graduation from Washington College in 1937. In 1940 he was made Sales Manager for the company's line of woven wire conveyor belts, industrial wire cloth, woven wire slings, and special metal fabrications. Mr. Evans was made Secretary and Treasurer in 1942 and held this position until his present appointment.

Miss Pink joined the company in 1930 and was made Office Manager in 1940. She became Comptroller in 1944 and held that position up to this time.

GLASS FIBERS TO MOVE EXECUTIVE OFFICES

Glass Fibers, Inc. has signed a lease for the entire second floor area of the new building being constructed at 1810 Madison Avenue, Toledo, Ohio, by The Manhattan Building Company. Announcement of the proposed tenancy was made jointly by F. H. May, Jr., Vice President of Glass Fibers and by George Banta, Secretary-Treasurer of the building organization.

The floor area, totaling 7,620 square feet, will be occupied by the executive, administrative, and sales staffs of the glass concern. An extensive display room, utilizing latest techniques, will house prime and end products made of glass fiber materials, according to F. J. Solon, Jr., Public Relations Director of the firm. Completion of the new space is set for early March when the executive group will move from its present offices.

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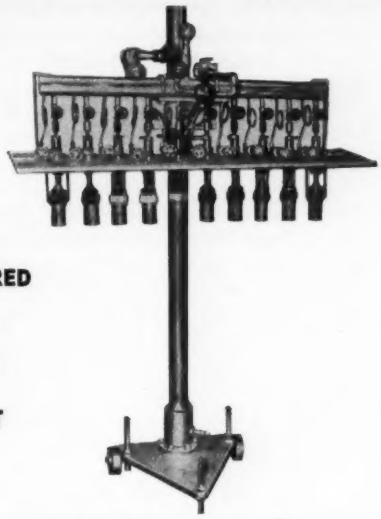

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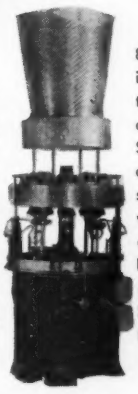

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AUSTRALIAN PROGRESS . . .

(*Continued from page* 23)

port market. Otherwise Australia's increased use of glass, together with a population being expanded by planned and assisted immigration, rules out the likelihood of export for some time.

W. J. Smith, Managing Director of Australian Consolidated Industries, is the guiding force of glass production and one of Australia's most colorful industrialists. Born in England in 1882, he joined the original Australian Glass Manufactuers' Company in Melbourne at 12, as a water boy. His rise was fairly rapid. On the reorganization of the company in 1916 he was appointed General Manager, later Managing Director. When the company was absorbed into A.C.I. he retained that position. During World War II, he was Director of Gun Ammunition Production, Ministry of Munitions, from 1940 to 1942.

W. J. Smith and his brother, A. E. Smith, as General Manager, run the A.C.I. industrial empire with a hand-picked team of alert, hard-working executives.

Focal point of the A.C.I. glass production policy is to keep prices stable despite rising costs. This, of course, can be done only by ever more efficient management. Price stability, in part, accounts for the constantly increasing demands for Australian produced wares. Labor shortages have been met in some degree by the current nationally-planned immigration program—former European "displaced persons" as well as other migrants are on the factories' payrolls.

Mr. Smith has implacable faith in Australia's industrial future. He believes the field is wide open for the expansion of enterprise. On that note his organization is moving forward.

RESEARCH DIGEST . . .

(*Continued from page* 33)

Editor's Note: The actual graphs for two soda-lime-silica glasses in the water test deviated from the straight lines more than those for borosilicate glasses.

Editor's Note: The following abstract is from a paper given at the 1950 National Technical Conference, Illuminating Engineering Society. While the subject matter does not deal directly with glass technology, it is of interest to glass technologists as it shows the end use of some recent developments in the field of glass.

New Photochemical Lamps. By L. E. Barnes, Westinghouse Electric Corporation, Bloomfield, N. J.

New photochemical lamps have been developed using new glass and new electrodes which are better adapted to the operating conditions of modern whiteprint machines. They have higher ultraviolet output, more uniform output because of reduced sensitivity to drafts, and longer life which is practically independent of the number of times lamps are turned on.

"Diazo" compounds used as a sensitized paper emulsion in whiteprint processes have a spectral sensitivity in the ultraviolet region adjacent to the visible spectrum. A medium pressure mercury arc is used to obtain the

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best efficiency of output in this spectral region. To accommodate high operating temperatures necessary to vaporize the mercury, it has been customary to use high-temperature glasses and fused quartz for arc tubes. However, the low transmission of such glass at high temperatures, and the problem of ozone when quartz was used, made these materials unsatisfactory. In recent years a new high-temperature glass with neither of these objectionable features has become available. The new lamps are made of this new glass.

The sensitized paper used in the whiteprint process should not be heated above 135°F., to avoid objectionable blurring due to the difference in expansion of the tracing and emulsion. To maintain low emulsion temperature, a cooling draft, which incidentally cools the lamp, is used. Mercury vapor lamps operate at a pressure determined by the coolest part of the lamp. In conventional tubular lamps, a critical spot has been the exhaust tip. In the new lamps the exhaust tip has been completely eliminated. The elimination of the exhaust tip not only has reduced the problem of lamp operation in drafts but also made unnecessary the special education of consumers to position the lamp with the exhaust tip at the warmest operating position.

Use of the new glass also permitted a reduction in bulb diameter. This reduced the area of the bulb exposed to the cooling draft thereby reducing sensitivity to drafts still more. The reduction in sensitivity to drafts results in uniform output along the length of the lamp.

The duty cycle of most photo printing machines is four hours per start. Some are used for even shorter periods. Electrodes and some photochemical lamps are of an oxide activated type which have a tendency to sputter emission material from the electrode when subjected to repeated starts and thus become deactivated. The new lamps use thorium (non-activated) electrodes which have the advantage of long life practically independent of the number of starts.

MINNEAPOLIS-HONEYWELL BROADENS SCHOOL ACTIVITIES

Customer employee courses that will be fitted to specific requirements of each of its industrial instrument users opened on January 8 at the Philadelphia school of the Minneapolis-Honeywell Regulator Company.

During the past year the school has expanded its activities. It held its first seminar for colleges and technical schools and concentrated sessions were held for chemical operating and equipment executives from nine foreign countries. In addition, specialized courses were held for several trade groups. Similar events are again being planned for 1951, according to the announcement.

The new courses will cover industrial instruments maintenance and repair and the classes will be held on a three, five, and thirteen weeks basis. The shorter courses will be for concentrated instruction, and the longer courses for more comprehensive training in complete industrial instrumentation.

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